

DEVELOPING UNIT TESTS

BIOLOGICAL SCIENCE

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F O R E W O R D

The present brochure on "Developing Unit Tests" provides some illustrative material on the various aspects of Item-Writing and preparation of Unit Tests. Six parameters which guide and control the art of Item-Writing, namely, the instructional objectives, content, teaching-learning process, purpose of evaluation, forms of questions, and maturational level of pupils have been attempted to be introduced by the document. It also highlights the need of preparing unit tests and offers know-how on developing them. This is likely to create awareness of the various issues involved in writing an item and preparing Unit Tests and help functionaries involved in the process of teaching and testing in improving the quality of their work and that of education as a whole.

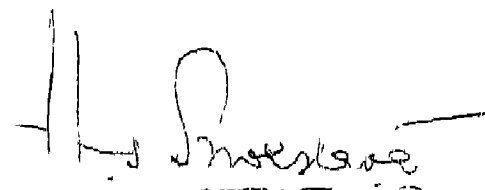
Such instructional material is a genuine need as it provides the requisite know-how to the practicing teachers, item-writers and paper setters for bringing about the desired improvements in their evaluation ventures and testing in the light of the nationwide demand of improving the quality and standard of school education with a view to bringing it at par with internationally accepted standards.

As per, our usual practice of offering such materials for a thorough scrutiny by a wider cross-section of the academicians, this draft document is being forwarded with the hope of receiving comments and observation for further improving the document. It is hoped that our teachers will make use of it for improving the effectiveness of the teaching learning situations they offer to the students.

Shri J.P.Agarwal, Reader in the Department has put in a diligent effort in the preparation of the document with an immediate functional value and I congratulate him for this valuable venture.

New Delhi

the 20th March, 1985



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P R E F A C E

Public examinations control and govern the entire system of education in our country. More generally, they are used for seeking evidence on pupil achievements for the purpose of classification and certification. Their more useful functions are either not realised or ignored. The unit tests and periodical examinations, if planned and administered appropriately with adequate emphasis on analysis of pupil results are liable to offer valuable information for improving the instructional programme to make it more realistic, effective and efficient on one hand and to promote better pupil learning on the other. This needs three major aspects for consideration, viz (a) to introduce unit approach in teaching and testing making examinations more and more comprehensive, (b) to improve the tool of measurement and (c) to incorporate an element of analysis and interpretation of pupil results to offer feed back to teaching-learning process as well as to promote pupil growth.

The First aspect needs to imply 'unit approach in teaching and testing'. This forces to develop regular study habits and discourages selected study. At the same time it makes evaluation as an integral part of the teaching learning process and offers feed back to improve teaching as well as promote better learning. It is also helpful to include all areas of pupil growth, i.e. intellectual, emotional, physical, social and vocational for measurement with a view to provide opportunities for their

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their development in the desired direction. The second aspect involves the improvement of question papers to make them valid and reliable tool of measurement as well as to employ additional tools and techniques to cover other aspects of learning outcomes for measurement. For bringing desired improvement in the questions which occupy the central position in the entire system of evaluation, The Third aspect is dependent on the second, for no analysis of a given data can serve a fruitful purpose if it is not based on a valid and reliable data.

It is hoped that the present brochure would be useful for the teachers in providing handy material on preparing unit tests as well as good questions. However, it is open for their comments which will ^{be} thankfully acknowledged and considered while preparing the final version of this brochure for publication.

NEW DELHI

March, 1985.

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CHAPTER 1

UNIT APPROACH IN TEACHING AND TESTING

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Public Examinations exert an over whelming influence on our system of education. Both teachers and educational planners are unaware of this fact. This is largely because these examinations are confined to measure pupil achievements for the purpose of classification, certification and grading of pupils. Their more important roles, i.e. in diagnosing pupil weaknesses, assessing effectiveness of the teaching-learning programme, offering guidance to promote better learning etc. are almost completely ignored. This has made teaching examination oriented. Teachers are left with no option except to prepare their pupils to get success in the ensuing examinations. How to overcome this back-lash effect of examinations?

1.0 NEED OF UNIT APPROACH:

Unit approach in teaching and testing has a potential to overcome this problem because it makes teaching purposeful and objective-based, involves diagnosis of pupil weaknesses and remedial instruction, discourages selective study on the part of students, and improves the instructional programme. In fact, evaluation becomes an integral part of the entire teaching-learning process and serves to promote learning rather than to assess the learning outcomes.

2.0 WHAT IS A UNIT?

A unit of study is usually described as a comprehensive and significant aspect of learning. It involves a closely related subject matter. Thus, it is not merely a block of subject matter or a series of independent lessons. Generally, it represents a well connected learning tables around a central theme, a big idea, a major concept, or a broad generalization. Such a unit should be handy to introduce and also to review quickly both by teachers as well as pupils. Usually it is expected to be completed within 4-7 periods of work. However, the size of a unit may vary from stage to stage depending upon the maturation level of pupils and the depth of study desired. For example, "Plant structure and functions may be a suitable unit of study at the elementary stage requiring a week's work. But at the secondary stage, more depth is required and so "leaf structure and function", "source of energy for life", "perpetuation of life", etc. may constitute units of study.

Present-day syllabi and text-books, generally have unit organisation. In certain cases, the size of units is too large requiring 15-20 periods of work. Such unit may be regrouped or broken into meaningful units. Some teachers feel to consider chapters of a text-book as units of study. But certain chapters are too small and may be dealt within a period. In order to make teaching meaningful and comprehensive, it is expected that teachers will analyse the subject matter of these chapters/units in the light of instructional objectives designed to develop and then

form suitable units based on certain central themes or big ideas which may be completed within 4-7 periods of work. A suitable title should also be given to each of these units reflecting the central theme, big idea or type of work involved. In this way the entire syllabus or course of study is organised into units of study.

3.0 PLANNING FOR A TEACHING UNIT:

The form and style of planning a teaching unit may differ from one teacher to the other, but it should invariably involve content analysis, instructional objectives, teaching-learning experiences, major activities, unit introduction and review. An inclusion of instructional aids, pupils' previous knowledge, home assignments and suggested readings facilitates planning and execution of work. A unit test usually administered at the end of the unit provides useful data on pupil achievements, effectiveness of teaching and worthwhileness of the instructional programme. It is the major tool of the formative evaluation and must find a place in unit approach in teaching and testing.

. CHARACTERISTICS OF A UNIT TEST:

Unit test is an informal test designed and developed on a small block of content to reveal the effectiveness of the teaching learning programme. It is often described as the basic tool of the formative evaluation rather than of summative evaluation. It is administered immediately after the completion of work under a unit and does not provide formal time for preparation to the pupils. It can use various

types of tests of evaluation and is not always confined to the devices used in public examinations. Written and oral tests, observations, interviews, discussions, home assignments involving varied activities, and other types of tools securing evidence on the accomplishment of the desired behavioural outcomes can be used for this purpose.

The evidence secured through a unit test is used immediately to improve learning, i.e. remedial instruction to overcome pupil weaknesses, and even assessment and modification of instructional objectives and curricular materials.

5.0 PLANNING OF A UNIT TEST :

Planning of a unit test begins with the work of planning of a teaching unit as it depends on the instructional objectives formulated, content elements selected for study and teaching-learning activities outlined. To secure evidence on the accomplishment of the pre determined objectives, a design and a blue print are prepared giving due weightages to the forms of questions (or other tools of evaluation), various objectives and sub-units of the subject matter. The test paper is developed based on the blue print and administered to get the evidence. The results are then analysed and used to improve pupil learning as well as to modify teaching programme accordingly.

6.0 USES OF A UNIT TEST

A unit test as emphasized earlier is the device to diagnose

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weaknesses and strengths in the teaching programme and improve the same to promote better learning. In this way, it serves several purposes.

6.1 Diagnosing pupils' strengths and weaknesses :

A unit test reveals the weaknesses and strengths of a pupil which can be overcome by remedial instruction. Future steps may also be known to prevent create such weaknesses.

6.2 Assessing pupils' progress :

The unit test provides data on a pupil's achievement. On analysis, his/her progress may be ascertained in the light of his abilities and previous achievements.

6.3 Motivating the learner for studies :

A unit tests forces a pupil to study regularly. This leads to promote better learning.

6.4 Assessing effectiveness of teaching :

The areas poorly learned by the majority of the pupils reflect either poor teaching or too high curricular materials and the expected learning outcomes. This needs modification in teaching and reformulation of instructional objectives. This may bring improvement in teaching as well as in the curricular programme.

Unit Tests can also be used as periodical tests under Internal Assessment for gathering data for promotion to the next higher class.

DERIVATION AND CLASSIFICATION OF INSTRUCTIONAL OBJECTIVES

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India is a Sovereign Socialist Secular Republic with rich cultural heritage and high ideals and values. It needs to maintain its unity among the diversities of customs and traditions, languages and dialects, religions and the like. Only the properly educated individuals can preserve and transform our cultural heritage, maintain ideals and values, fulfil needs and aspirations of manpower supply and technological advancement, defend frontiers and work to make India as a strong and advanced nation in the world. The Educational Institutions will have to work conscientiously and consistently for shaping young children into self-reliant, emotionally balanced and socially useful citizens of tomorrow. This means a provision of well planned and purposeful education for which derivation of instructional objectives to bring the desired change in the pupils and organisation of objective based teaching-testing programme are the first requisite.

1.0 NATURE OF INSTRUCTIONAL OBJECTIVES:

What is an (educational or instructional) objective?
According to E. Harper, 'Objectives are the statements of expected results'. This means that an objective states the way in which the pupils will be different at the end of teaching of a particular topic, unit, or course from what they were at the beginning. This difference is often in the form of overt behaviour

and so can be measured with the help of appropriate tools and techniques. Thus, the instructional or educational Objectives are the "changes in pupils' behaviours" or "behavioural outcomes" desired to develop directly or indirectly as a result of teaching. As these changes in pupils' behaviour are deliberately desired for development in the best interest of the society as well as of the learners, they carry a value of 'goodness' or 'usefulness'. This reflects 'normative nature' of an objective.

A.H. Upasani considers objectives as 'policy statements of education'. This means, an objective should state;

- (i) a desirable behaviour for development in accordance with values and ideals of the society rather than a value or ideal,
- (ii) a pupil's overt behaviour arising at the end of the learning-learning process rather than the learning experience,
- (iii) a product of learning or a learning outcome instead of the process of learning (teacher-pupil activities)
- (iv) a pupil's performance or his terminal behaviour instead of the teacher's performance or his methods of teaching,
- (v) a change in pupil's behaviour rather than the learning of content and materials bringing about this change.

2.3

In essence, an instructional or educational objective represents a desirable change in a pupil's overt behaviour related with the product of learning which is usually terminal, meaningful, attainable and measurable. It provides direction for the pupil growth and controls the entire process of teaching including content, methods, materials, motivations and evaluation. There is no need to confuse with several terms in use, like aims, purpose, goals, intentions, behavioural outcomes, general and specific objectives, long-range and short range objectives, direct and indirect (vicarious) objectives which carry almost always one and the same meaning. However, an objective may vary in the degree of generality while stating them at various levels, e.g., elementary education level, class-wise subject level, unit level, topic level, etc. The lowest level objectives are stated in more specific terms both behaviour as well as content point of view but gradually merge into the higher level objectives. Thus the former are just extensions of the latter.

2.0 PURPOSE AND NEED OF FORMULATING INSTRUCTIONAL OBJECTIVES:

Instructional objectives or expected learning outcomes are required for the purpose of communication to teachers, pupils and examiners in order to clarify them what is expected of the student at the end of a given period of study (E. Harper). Besides this, it provides guidance and control over the entire teaching-learning programme with an element of feedback to

promote pupil growth as well as to secure an active student involvement in learning by making them aware of 'what is expected of them'.

1 The instructional objectives direct pupil growth:

Pupil growth means a balanced development of intellectual, emotional, physical, social and vocational aspects of the human personality. The instructional objectives state them explicitly as pupil behaviours related to desired abilities, skills and attitudes for communication to the curriculum users, i.e. teachers, pupils and examiners. Syllabuses and text-books provide only a list of content units and within units content elements with varying degree of depth. Until and unless, the text-books are handled purposefully to direct development of desired qualities, they do not promote pupil growth. They remain confined to serve the purpose of content banks which if not up-dated in later life may become obsolete, and also liable to be forgotten. While the abilities and skills acquired and the attitudes formed in accordance with instructional objectives are easily retained and used to solve life-problems as well as to behave as socially useful citizens. With this point of view, the use of text-books is recommended as data source in realising instructional objectives in order to ensure pupil growth in the desired direction.

2.2 The instructional objectives guide and control the entire teaching-learning programme:

Instructional objectives communicate/offer clear guidance to teachers and examiners on 'what is expected of pupils after having gone through' a particular course of study. This helps teachers in choosing the best 'teaching-learning processes', i.e. the content, methods, materials, pupil motivations, evaluation techniques and feedback in order to offer most appropriate 'teaching, learning experiences' (figure 1). Testing becomes part and parcel of the teaching learning programme with provision of feedback to it more effective and efficient. This also makes it objective based and purposeful. Text-books, teachers' guides and students' guides for the text-books help in realising the objectives.

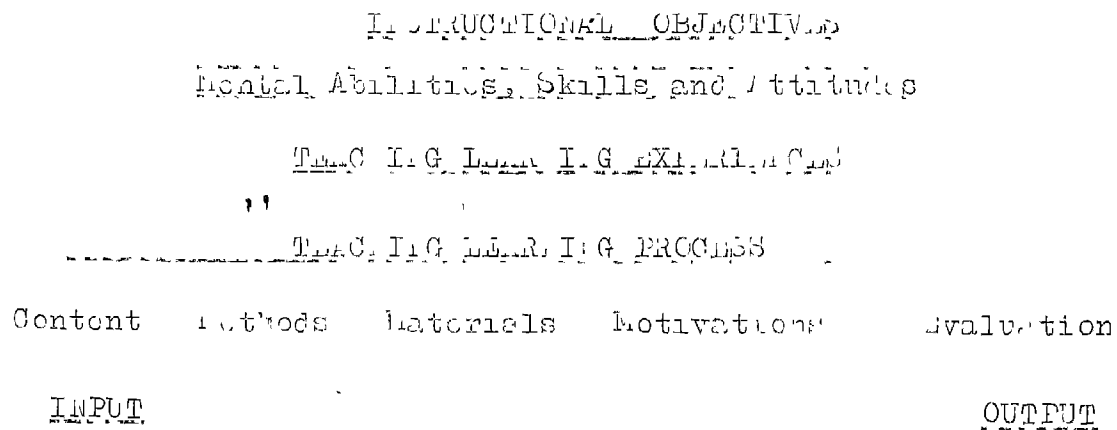
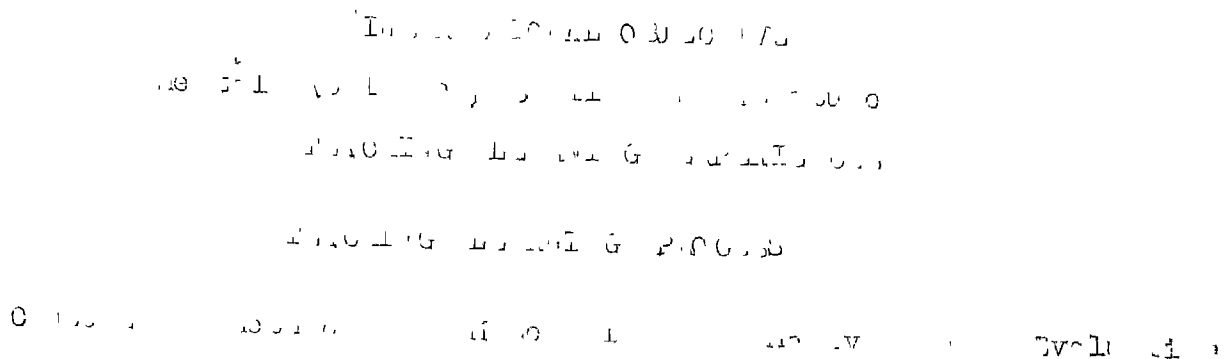


Figure 1 : Role of Instructional Objectives on teaching and testing.



2.3. PUPIL EVALUATION PROMOTES BETTER LEARNING:

Pupil evaluation involves an element of analysis and interpretation of pupil performance in periodical test and terminal examinations including, sometimes, the public examinations too. This analysis may reveal weaknesses of pupils in certain areas as well as inappropriate aspects of the teaching programme. A careful teacher may take care of pupils' weaknesses by improving instruction as well as arranging remedial measures. This helps in promoting pupil's better achievement and improving of efficiency and effectiveness of teaching.

2.4 Instructional Objectives develop active student involvement in learning:

When a student knows what is expected to learn, he takes initiative for his own study outside of class-room. Statement of expected behaviours when made known to pupils motivates them to acquire and develop stated abilities and skills. Learning becomes meaningful and purposeful for them. They participate in the learning process actively instead of remaining passive receivers; they can select appropriate materials from the text-book and other sources and even initiate discussion in the class-room.

3.0 DERIVATION OF INSTRUCTIONAL OBJECTIVES:

Systematic work to derive educational objectives is still in an incipient stage. So far, the subject matter or knowledge has been almost the sole consideration for determining objectives of education. This has widened the gap

between the school and the rest of life of individuals as well as between school and society. The individuals have already been affected adversely in their intellectual, physical, vocational and physical needs as reflected in. In fact, in order to show young children that self-reliant and self-useful citizens of the future, knowledge or wisdom under different subject fields should be used fully as means to ensure a steady growth of pupils in their thinking and in itself. While such a change is now blowing, which is, though slow but, no doubt, steady. Several sufficient 0-level projects have given priority to education over subject areas. M.O.B.R.T. too has started pioneering it. This involves a due consideration of the career determination, educational objectives.

Mc Neil (1969) emphasized that the subject matter, the learner, and the society, all should be considered as data sources in order to formulate instructional objectives. This, however, limits the resources, both human and physical which while affecting the accomplishment of objectives, limit them in their length and breadth. Therefore, it would be useful to base our educational objectives on these four determinants, i.e., the society the learner, the nature of the discipline and the resources, and not to lean too much towards one or the other source, but to keep a balance among all of these.

3.1 Society as determinat of educational objectives:

It is needless to say that society is the most powerful claimant to declare what is expected of to days pupils after having received the education, for the schools and colleges are social institutions created, financed and maintained by her in order to fulfil her own needs and aspirations. There may be such needs as preserving and transforming the cultural heritage, instilling democratic values of life, providing skilled manpower and defending the freedom and unity of the country. Therefore, every society aspires to educate pupils in order to make them self-reliant and emotionally balanced individuals as well as socially useful and responsible citizens. Various commissions and committees in education in India and abroad have reiterated these needs and aspirations time to time.

As early as 1918, the Secondary Education Commission in America stated the seven cardinal principles of education, health, command of fundamental processes, worthy home membership, vocation, citizenship, worthy use of leisure, and ethical character. The latest Indian Education Commission (1966), popularly known as Kothari Commission has clearly stated the needs of democratic India for fulfillment through education e.g., preparing for the democratic way of life, inculcating spirit of secularism, providing work experience to pupils, equipping to live in rapidly advancing world of science and technology, etc. Recommendations of the Education Commission

policy statements of the Government on education and research studies of eminent scholars in the field lead to develop educational objectives at the national level reflecting the social needs, cultural heritage and constitutional obligations for fulfilment in order to maintain India as sovereign socialist secular democratic Republic following the path of justice, liberty, equality and fraternity.

.2 Learner as the determinant of educational objectives:

The learner contributes for the determination of educational objectives indirectly. Success of teaching depends largely on the learners who are at the receiving end of the educational process. Their needs and aspirations force to formulate additional objectives. For example, every individual needs a physical, emotional and social security as well as aspires success in life, earning his livelihood honourably and securing social prestige and goodwill. For fulfilling these needs and aspirations, pupils are to be equipped with certain abilities, skills and attitudes which are to be incorporated explicitly in the educational objectives. In no case, these objectives are in contradiction with the needs and aspirations of the society. In fact society, too, aspires that their future citizens should be self-dependant, open-minded and socially, useful individuals.

Interests, aptitudes and abilities of the learners do exert some influence on the educational objectives but, more exactly, direct curriculum organization and teaching techniques.

Their maturation level and educational standards also limit the scope of educational objectives. Educational and social psychologists help educationists in this regard while determining and formulating educational objectives, properly graded for various levels of education.

3.3 Discipline as determinant of educational objectives:

The disciplines have always exerted an overwhelming influence on the determination and formulation of educational objectives. The emphasis on acquisition of knowledge has been so much that it has become the sole objective of education. It has not only hampered in developing pupils, balanced personality but also choked the growth of the discipline itself. But even then the nature and philosophy of a subject must be considered alongwith other determinants. The nature and philosophy of science can be defricted by three interpenetrating components, i.e. the Body of knowledge, the Methods of making inquiry, and the influence on the environment and man (school Councils, 1974). This means clearly that teaching of science can not be confined merely to body of knowledge but rather will have to base on both processes and products of science on one hand, and its impact on the society at large on the other hand. Science is a social force or influence and an essential part of culture and, so derivation of educational objectives based on the nature and philosophy of science will bring no conflict between science and society. Therefore, there is a need to

derivation of objectives after having considered the nature and philosophy underlying a discipline rather than its knowledge component alone. A model for depicting the nature and philosophy of a discipline is outlined in figure 2.

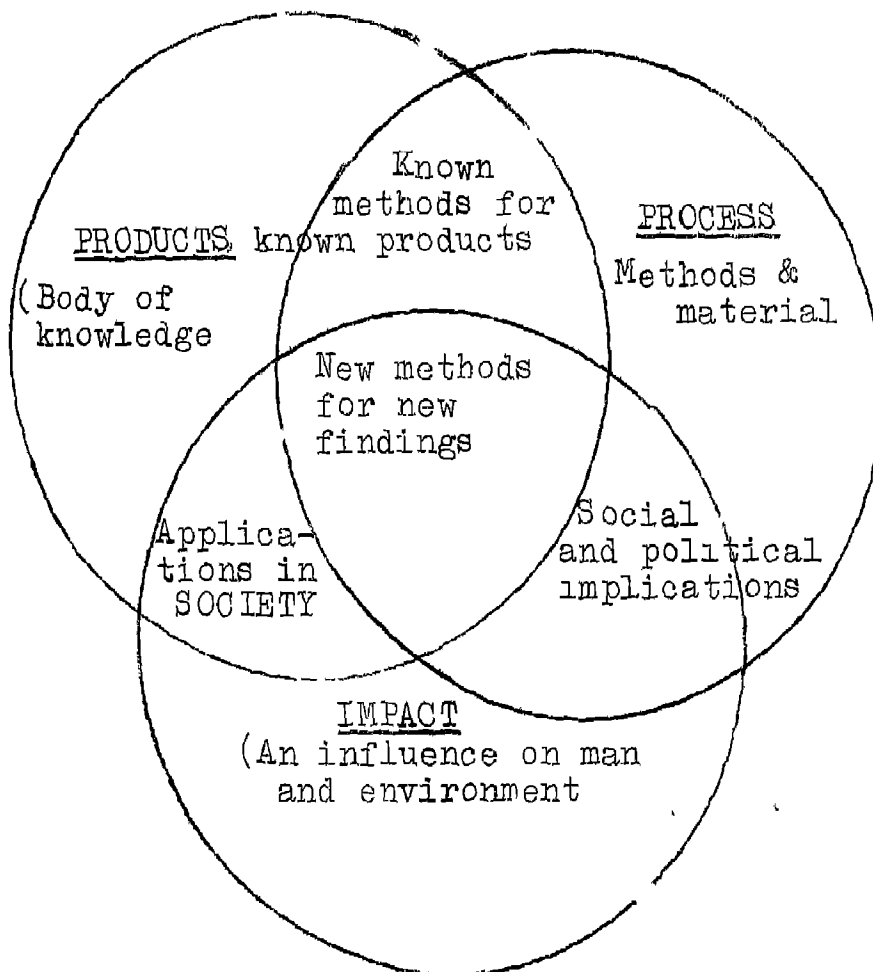


Fig. 2: A model for depicting nature & philosophy of a discipline

3.4 Resources as determinant of educational objectives:

Resources are not considered to be the direct sources of educational objectives, rather realization of educational objectives depends largely on them. Therefore, it is very much needed to visualise before hand the human and physical facilities, school environment and funds for making provision for additional equipment, reference materials, audio-visual aids, and in-service training of teachers. While doing so, the attainability of the educational objectives is enhanced, and at the same time some instructional objectives are likely to be added, e.g. in science subjects, improvisation of apparatuses, collection of materials and their preservation etc.

4.0 NEED OF A CLASSIFICATION MODEL:

The educational objectives when formulated specifically for accomplishment in a particular subject, may produce a very long list of statements involving repetition, overlapping, contradiction, scattering, unwieldiness and discontinuity. To avoid these problems classification schemes can be developed as followed in biological sciences where organisms, on certain approved criteria, are arranged into phyla, classes, orders, families and genera.

A classification of educational objectives makes the list of objectives handy by arranging objectives into c

categories and sub-categories. It also overcomes the problem stated above. By identifying the major categories of objectives and stating objectives at desired level of generality, the problem of unwieldiness can be looked into. This also helps in locating repetition, contradiction and overlapping of objectives. It would also reveal what other objectives have been left out. If the classification arranges the objectives in an order of increasing complexity, the problem of discontinuity will no longer remain. Thus, a suitable system of classification for instructional objective is a must. Therefore, several educationists have worked hard in order to evolve some suitable classification models.

5.0 BASIC CRITERIA OF THE CLASSIFICATION MODELS:

For developing a workable system of classification appropriate criteria are to be determined for categorising objectives. In fact, it needs a logical scheme for grouping objective which may be meaningful, handy and useful. Each statement of an educational objective has two distinct components, i.e., a modification part directing the pupil behaviour, and the other content part relating relating the behaviour with subject matter. A few workers tried to develop classification models with the latter component. The subject oriented classifications, so developed, were much complex with unending list of objectives or too general to offer any effective control over the teaching learning programme. But the process oriented classifications when

evolved on the basis of the modification part were found workable. In fact, education is concerned to bring about a change in the behaviour of the learner, and so classification of objectives should be based on the behavioural part of the objectives. The content part may be tagged to the classified behaviours. Such a system is expected to give categories of behavioural objectives quite common in most of the subjects. This would not make the list of objectives shorter but also helps in comparing pupil achievements in their two or more subjects of study.

There was one more problem still left unsolved with the taxonomists and that was how to arrange behaviours into various categories and sub-categories. Bloom and his associates developed an hierarchical system for arranging various categories of behaviours (or objectives) in an ascending order of complexity, based on mental operations involved. For example, "to recall of characteristics of the family cruciferae is similar than "to enumerate differences between cruciferae and Malvaceae".

2.0 BLOOM'S MODEL:

Bloom and his associates has adopted a tripartite division of the entire realm of mental life, i.e. cognitive, Affective and Psychomotor domains concerning to knowing, feeling and doing aspects of behaviours respectively. The basic features of these classifications include:

identification of major categories of behavioural objectives and arranging them in an hierarchical order of complexity in mental operations, sub-divide the categories into sub-categories using a decimal system, tagged content elements with the categories and sub-categories, and cumulative nature of the categories to maintain continuity from simple to complex.

6.1 COGNITIVE DOMAIN:

This classification scheme was available in 1956 and is found most workable with almost all subjects of study and for all levels of education. The various categories and their sub-divisions are mentioned here (B.S. Bloom et al 1956).

1.00 KNOWLEDGE

1.10 Knowledge of Specifics:

- 1.11 Knowledge of terminology
- 1.12 Knowledge of specific facts

1.20 Knowledge of ways and Means of dealing with Specifics:

- 1.21 Knowledge of conventions
- 1.22 Knowledge of trends and sequences
- 1.23 Knowledge of Classifications & categories.
- 1.24 Knowledge of Criteria
- 1.25 Knowledge of Methodology.

1.30 Knowledge of the Universals & Abstractions in a field:

- 1.31 Knowledge of Principles & Generalizations.
- 1.32 Knowledge of Theories & Structures

2.00 COMPREHENSION:

- 2.10 Translation
- 2.20 Interpretation
- 2.30 Extrapolation

3.00 APPLICATION

- 3.10 Applications of known principles and generalisations in unfamiliar situations.

4.00 ANALYSIS:

- 4.10 Analysis of elements
- 4.20 Analysis of Relationships
- 4.30 Analysis of Organizational Principles

5.00 SYNTHESIS:

- 5.10 Production of a unique communication
- 5.20 Production of plan or proposed set of operations.
- 5.30 Derivation of set of Abstract Relations

6.00 EVALUATION:

- 6.10 Judgement in terms of internal evidence
- 6.20 Judgement in terms of external criteria.

The six categories of behaviours in this scheme are arranged simple to complex. Each category, in addition to its own, includes the mental operation involved in the former category or categories, thus possessing cumulativeness and thereby maintaining continuity. In other words, the category of "Application" is equal to "understanding plus application", or even "knowledge plus understanding plus application".

6.2 AFFECTIVE DOMAIN:

This domain deals objectives concerned with 'feeling' aspects of learning. Dr. Krathwohl et al (1964) developed this scheme under the leadership of B.S. Bloom after a

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pains-taking team work. This taxonomy is developed on the parallel lines to the earlier one, arranging objectives involving initial and simplest behaviours through value guided behaviours to behaviours ~~ex~~pressed in accordance to one's conscience. The major categories and their sub-divisions are mentioned here:

- 1.00 RECEIVING (=ATTENDING)
 - 1.10 Awareness
 - 1.20 Willingness to receive
 - 1.30 Controlled (or Selected) Attention
- 2.00 RESPONDING:
 - 2.10 Acquiescence in responding
 - 2.30 Satisfaction in response
- 3.00 VALUING:
 - 3.10 Acceptance of a value
 - 3.20 Preference for a value
 - 3.30 Commitment (Conviction)
- 4.00 ORGANIZATION:
 - 4.10 Conceptualization of a value
 - 4.20 Organization of a value system
- 5.00 CHARACTERIZATION BY A VALUE OR VALUE COMPLEX:
 - 5.10 Generalized s t
 - 5.20 Characterization

The taxonomy of the Affective domain is much less popular partly due to comparatively less emphasis on affective objectives for accomplishment in the schools and partly because teachers still feel to use-categories like appreciations, interests, attitudes, values and habits.

In fact, those traditionally classified affective objectives involve overlapping values. However, the 'Rajasthan scheme of comprehensive Internal Assessment' deals some of the affective objectives in a much better way under the 'person and social qualities', 'interests' and 'attitudes'.

6.3 PSYCHOMOTOR DOMAIN:

This domain includes behavioural objectives pertaining to skills (doing aspects of human learning).

6.3.1 SIMPSON'S MODEL:

Elizabeth Simpson (1966) and her associates has outlined a system of classification for the psychomotor domain on the similar lines as are the two classifications for the cognitive and affective domains. The major categories and sub-categories are mentioned here:

1.00 PERCEPTION:

- 1.10 Sensory stimulation
- 1.20 Cue selection
- 1.30 Translation

2.00 SET

- 2.10 Mental set
- 2.20 Physical set
- 2.30 Emotional set

3.00 GUIDED RESPONSE

- 3.10 Imitation
- 3.20 Trial and error

4.00 MECHANISM

- 4.10 Patterning of responses

5.00 COMPLEX OVERT RESPONSE

- 5.10 Resolution of uncertainty
- 5.20 Automatic performance

6.00 ADAPTING AND ORGANIZATION:

(Developing New Patterns of action)

- 6.10 Improvisation
- 6.20 Modification

This taxonomy has not yet been worked out fully and still needs further development.

6.3.2 R.H. DAVE'S MODEL:

R.H.Dave (1968) in his paper presented at the International Seminar on 'testing' organised at Berlin outlined a classification model for the Psychomotor Domain which was well thought out and tried out in detail. The major categories and sub-divisions are mentioned here.

1.00 IMITATION:

- 1.10 Impulsion
- 1.20 Over repetition

2.00 MANIPULATION:

- 2.10 Following direction
- 2.20 Selection
- 2.30 Fixation

3.00 REPRODUCTION:

- 3.10 Reproduction
- 3.20 Control

4.00 ARTICULATION:

- 4.10 Sequence
- 4.20 Harmony

5.00 NATURALISATION:

- 5.10 Automatism
- 5.20 Routinization.

This model presents from the acquisition of simple and complex skills to their mastery and bringing them in habit as reflex actions.

6.3.3 HANNAH AND MICHAELIS MODEL:

L.S. Hanna and J.C. Michaelis (1977) has further elaborated the hierarchical classification of the Affective domain which has been advanced by Prof. R.H. Dave (1968).

1.00 Imitating: Performs the steps demonstrated by the teacher. Abilities: Observing, remembering, copying and reproducing.

2.00 Patterning: Practices step by step under the teacher's instruction (without actual demonstration) as well as independently by trial and error. Abilities: Comprehension of instructions, remembering of instructions, translation, trial and error efforts, blending of steps, independent execution.

3.00 Mastering: Independent execution of skills in a specific situation with precision and speed (out-lined instructions may be needed). Abilities: appropriate precision, speed, agility, coordination, adherence, proportion and strength.

4.00 Applying: Independent execution of skill in a desired schedule in a variety of situations with precision, speed and efficiency; recommends new situations for employing this skill. Abilities: identification of appropriate skills to solve problems, performing the task, precision, speed.

5.00 Improving: Independent and intentional execution of skill with bringing in it some modification or introducing new elements; uses the skill creatively and flexibly in a variety of situations; creates new patterns or sets up new experiments. Abilities: identifying a situation where a particular skill can be applied appropriately, modifying the steps of the skill, adapting or introducing new elements to the skill.

6.3.4 IMPLICATIONS OF TAXONOMY OF PSYCHOLOGICAL DOMAIN:

These taxonomies have influenced the identification of simple and complex skills and their grouping in major categories and sub-divisions with behaviours expressing their graded acquisition, mastery and independent execution with needed manipulative modification. The various categories of skills in biological sciences include Observational Skills (recognises relevant details, reads quantitative data), locates desired data, discriminates between related data and detects error), Drawing Skills (draws, labels, shows directions), Manipulative skills (Selects, handles, measures, sets the experiment, takes precautions, detects error and rectifies them, provides, calculates), Collecting Skills (locates, collects, preserves, mounts, displays) and Reporting Skills (records data, selects content and style, presents evaluatively). This would be useful to prepare instruction objectives for practical work in sciences for teaching and testing purposes.

7.0 INTERRELATION BETWEEN DIFFERENT DOMAINS:

The tripartite division of educational objectives into three domains followed in the Bloom's model is not a water-tight compartmentalization. This is simply to maintain classifications separately for the sake of convenience. Eisner (1968) has expressed similar views

in a learning model to demonstrate relationships among these three domains (Figure 3)

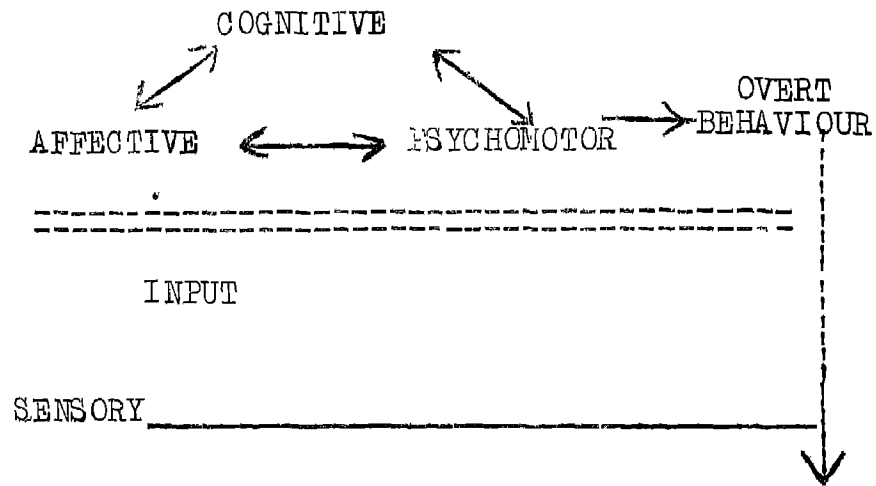


FIGURE: 3 Inter-relationship among the three Domains.

In this model the base line represents the barrier that plays between the conscious and subconscious mind. When this barrier is successful penetrated by a stimulus, the individual becomes conscious of it. At this stage, we say that the "awareness of stimulus" has achieved. Cognitive activity occurs to decide whether or not he is interested in its further exploration. If he decides for further exploration of the stimulus, a "tell me more" type reaction results which means curiosity has been developed. If he continues to give attention to the stimulus, the curiosity turns into interest. During this mental activity, psychomotor responses like observing, reading, writing, talking, etc. occur involving all the three aspects of learning i.e. Cognitive, affective and Psychomotor.

An interplay between these three aspects of the consciousness is thinking. New information is stored in the "individual's memory bank" as learning which is displayed by a psychomotor activity observable in the form of an 'overt behaviour'.

This model represents the learning process as well as inter-relationship between the three domains. And also that measurement depends on pupil's overt behaviours displayed with the help of psychomotor activity.

8.0 NCERT MODEL OF EDUCATIONAL OBJECTIVES:

National Council of Educational Research and Training, New Delhi has evolved a model on taxonomy of Educational Objectives. In essence, it adapts Bloom's approach but with simplification on one hand and further elaboration of the specifications. The first two categories of the cognitive domain are kept intact but remaining all other categories are assembled under one name APPLICATION. Thus, the application of N.C.E.R.T. model includes application, analysis, synthesis and judgement of Bloom's of the Cognitive Domain. Secondly the specifications given by decimal system are further elaborated to specify explicitly the mental operations.

A third modification is to keep all the these domains one after the other in a sequence cognitive- psychomotor- affective. The hierarchy of the behaviours according to

2.24

increasing complexity is maintained within the cognitive domain and work is going on to develop the same in terms of specific behaviours for the various skills as well as for the appreciations, interests, attitudes and adjustments. A list of Instructional Objectives of Biology at the secondary senior secondary stage is enclosed in Appendix-I

8—8

CHAPTER 3

TECHNIQUE OF CONTENT ANALYSIS

J.P. AGARWAL,
REDACTOR

Instructional objectives guide and control the direction of pupil growth to develop desirable behaviours related to intellectual abilities, skills, appreciations, interests and attitudes. But development of these behaviours does not take place in vacuum. It needs subject matter appropriate to initiate and promote pupil learning in the desired direction. Moreover, individual disciplines also demand acquisition of certain content elements involving the products and processes of the subjects concerned at different levels of education in order to ensure growth in them. Society, too, aspires that their future citizens are educated to form and develop the desired conscience and possess needed know-how and expertise to prove self-reliant and fruitful members of the society. All this needs a harmonious development of both content drawn from different disciplines as well as behaviours expressing intellectual maturity, emotional stability and social responsibility.

1.0 NEED OF CONTENT ANALYSIS

Syllabuses and textbook do spell out the subject matter in a graded way for different class-levels but, as such,

neither of the two, guide in specific terms to educate pupils through subject areas. Their emphasis remains by and large on the learning of content, and so, the teaching programme is liable to stress upon content learning rather than the pupils' education. In order to shift this emphasis towards the right direction, it is utmost essential to make the instructional programme objective oriented rather than to continue as content-oriented education. This is possible only when content is analysed and presented in terms of significant elements and that the teaching and testing is done for fulfilment of pre-determined educational objectives sampling appropriate content elements adequately.

The content presented in a textbook involves certain terms, facts, methods, principles, generalizations, etc. The relative emphasis on these elements may differ from one textbook to another. If the content analysis is made and the significant elements have been identified alongwith the desired emphasis, the textual material can be enriched if it warrants so. In other words, the content analysis offers an opportunity to reveal strengths and weaknesses of a textbook as well as to the enrichment of the curricular material. Even the over-emphasized elements in a text-book may be brought down to the level desired. A conscientious teacher, after having done the content analysis judges the worth of each element dealt in the text-book and prefers to send his/her comments to the author(s) and publishers on the poorly or over emphasize elements, thus forcing an improvement in the standard of the textbook.

In recent years the syllabi and text-books are modified drastically to make room for the study of newly emerged tools and techniques and the expansion of knowledge creating certain new fields of study. This is specially true for sciences and more so for biological science. Even the social sciences are no longer remained unaffected. But this curricular change is hardly to find in the class-room. One of the major reasons appears to be the attitude of a good majority of teachers who find it convenient to cling to their own conventional style of teaching selecting the same content year after year. Even the paper-setters and examiners have almost the same attitude. With the result, such teachers do not find these new textbooks suitable for their way of teaching. This is more so for the nationalised textbooks. Naturally, they then prefer to prescribe additional books. This adds a financial and physical (bag-load) burden over the pupils as well as increases undesirably the curriculum load. Content analysis may save from creating this problem. If these teachers undertake analysis of content, they would like to change their traditional way of teaching as well as refrain themselves from increasing the curriculum load.

In essence, the content analysis is a useful and purposeful activity both for teachers and examiners, for it helps in organising objective-based instruction, improvement and enrichment of textual materials, updating the content,

decreasing the curriculum load; and adopting the modern techniques of teaching. This is a handy tool for every teacher and paper setter providing detailed information about the subject matter coupled with objectives.

2.0 CONTENT ELEMENTS

Subject matter consists of certain basic elements such as terms, facts, conventions, trends, sequences (or process categories, classifications, criteria, methods, principles, generalisations (or concepts), theories and structures (major themes and patterns). All of these elements of subject matter can be picked up and expressed directly by their very name or written as concepts. For example, calyx, corolla, pollen are terms; These may be written as it is or each of these terms may be expressed as concepts directing the desired mental image or notion to be developed about each of these terms. Concept of the term 'Calyx' may be written as 'Calyx is the whorl of green leaves borne on the thalamus forming the outermost whorl to protect the other whorls of the flower during the bud stage'. Details of such concepts depend on the objectives determined by the teacher concerned. A teacher who intends to deal at a little higher level may express "Calyx forms the outermost whorl of a flower, generally green and concerned primarily with protection of other whorls of flower during the bud stage". In this case, it appears that the teacher intends to teach

this term with additional details. Thus, writing the various content elements in the form of concepts is useful but time-consuming and tire some task, and so, a teacher may device his own way of expressing them, preferably a blend of the two.

2.1 CONCEPT OF VARIOUS CONTENT ELEMENTS

It would be desirable to have some idea of the various content elements. A unit may have all or a few of them only. Bloom et al has identified about 14 such elements, most of which are stated here.

2.1.1 TERMS

Usually, a term is a word or expression with a special meaning. When used as a technical term in a particular branch of knowledge, it has a fixed meaning. However, there are certain terms used with different meanings in different context. For example, the term 'unit' is used in several branches of knowledge and so have a number of meanings, but with a fixed meaning for usage in a particular context. An item-writer uses the word 'unit' for an interconnected task for learning representing a theme or central idea, while a physicist uses as unit of measurement in a number of different dimensions. Therefore, only significant terms, new for a particular class, should be picked up to spell out their specific meanings for usage in one or more contexts. Chemical symbols, formula, technical terms, etc. are terms.

2.1.2 FACTS

Usually a fact means something that has actual existence or an event that has actually happened or is happening. For example, 'Hydrilla leaves contains chloroplasts' "On adding a little sodium carbonate to medium, rate of oxygen evolution increases from Hydrilla plants", etc. Select only new and significant facts. In fact, sciences are rarely taught at factual level and so, the list of facts should be much smaller in sciences than the subject which need teaching of facts and figures more.

2.1.3 TRENDS AND SEQUENCES

Trends, usually, express a general direction or course of development, while sequences mean a group of things arranged in an order specially following one another in time. A sequence may mean a scientific process showing the order in which things or events follow one another, e.g. "fixation of carbon dioxide in photo synthesis". Both of these content elements may be grouped under the head "processes".

2.1.4 CATEGORIES, CRITERIA AND CLASSIFICATION

A category means a division or class in a system for dividing objects into groups according to their nature, e.g. Amphibia, photosynthetic and chemosynthetic bacteria. When characteristics of a particular category are to be learned, it should be listed as category. Classification deals categorising things on the basis of one or more criteria. Plant classification

and periodic table are the results of classification. Placing plant-leaves into different categories on the basis of their shape or leaf incision is the act of classification.

A criterion is the established standard on which a decision is made, e.g., criteria for classification of plants and animals.

All of these three content elements are interconnected and so may be placed under "classifications".

2.1.5 METHODS AND CONVENTIONS

Methods are the procedures used for the study of something. Experimental procedures fall in this category, e.g. 'Procedure to set an oxygen evolution experiment to demonstrate photosynthesis in Hydrilla plants. On the other hand, conventional mean accepted practices, e.g. placing chemicals in an alphabetical order.

Both together may be placed under "Procedures".

2.1.6 CONCEPTS, PRINCIPLES AND GENERALISATIONS

A Principle or Law is the scientific truth used as a base for action. For example, Archimedes Principle, Principle of Segregation. Second Law of thermodynamics. Generalisations on the other hand, are the general rules or wide spread principles or opinions arrived after having considered several cases. In fact, generalizations result from inductive thinking and if made cautiously, speak the truth universally. For example, "all plants and animals are made of cells".

This generalization hold true like any scientific principle but can not be proved true by direct experimentation. Principles and laws result from deductive thinking and can be proved true under controlled conditions.

Concepts are lower level generalizations and are stronger than facts (Charlotte F. Gilman). It usually represents a mental image or generalised notion or impression formed about certain things, happenings, etc. It may or may not be universally applicable like generalizations and even wrong concepts may be developed based on incomplete and improper observations. Our aim as teachers is to help pupils in developing desired concepts based on several valid observations.

A concept may be of terms, facts, processes, methods, or principles. Because in teaching we expose pupils to various learning situations and as a result of which they form generalised image about these materials as concepts. It would, therefore, be useful to write to various content elements in terms of concepts.

2.1.7 THEORIES AND STRUCTURES

Theories are the explanations and well thought out speculations about certain events, abstract principles and phenomena of the nature for which certain proof is still needed but which appears to be reasonable. For example, Darwinism, theory of relativity, etc. Structures, Patterns

and Themes are the generalisations of the highest order revealing the unifying threads, systems and ways in which parts are formed into whole. The B.S.C.S. Programme in U.S.A. has called them conceptual schemes. Some examples are change of living things through time, Genetic continuity of life, Regulation and homeostasis, Complementarity of structure and function, Complementarity of organism and environment; etc. Nuffield Foundation Science Teaching Project in o-level science courses has also emphasized certain themes like 'the perpetuation of life', Newtonian dynamics, etc.

2.2 REGROUPING OF THE CONTENT ELEMENTS FOR CONTENT ANALYSIS

There are about 14 categories of content elements. Some of them are ~~inter~~linked and so, may be placed together. This would facilitate the task of analysing the content of a unit or of the entire course in terms of content elements. The various categories may be grouped into the following six categories only.

1. Terms
2. Facts
3. Procedures/techniques (conventions & methods)
4. Processes (trends and sequences)
5. Classifications (criteria, categories and classifications)
6. Concepts and generalizations (concepts, Principles, generalization, theories and structures)

There is a ~~tendency~~ tendency, specially in sciences, to state all of these content elements in the form of concepts as they reflect the length and breadth desired to be accomplished under each content element.

3.0 PROCEDURE OF CONTENT ANALYSIS

Content analysis usually involves three major steps, i.e. organization of the entire content into certain meaningful units, selection of content elements (unit-wise and topic-wise) and statement of content elements in a suitable form.

3.1 UNIT ORGANIZATION

The first task for the content analysis is to organize the subject matter outlined in the syllabus and also in the textbook(s) into certain meaningful units. A unit is not merely a piece of subject-matter but a well connected learning tasks around a central theme, big idea, major concept, or generalization. Such a unit should be handy to introduce and to review both by the teacher as well as by the pupils. It is, usually, expected to be completed within 4 to 7 periods of work. Present-day syllabi and text-books, generally, have this type of organisation. In that case, a chapter of the book/syllabus

are Root structure and function, stem structure and function, Leaf structure and function, etc. For higher secondary classes in Biology, there may be units like 'Source of Energy for Life (Photosynthesis and Respiration)', "Perpetuation of life" (Heredity and Evolution), etc.

3.2 SELECTION OF CONTENT ELEMENTS

A unit may then be analysed for its content elements. Select only those elements of the subject matter which are significant and desired to be learned by the pre-determined educational objectives at the course level as well as further elaborated at the unit level. In other words, these should be new and very well connected with the unit of learning.

3.3 STATEMENT OF CONTENT ELEMENTS

The selected elements of a unit should be stated meaningfully. They should spell out what is to be learned about them. A usual practice is to state them in terms of concepts. This helps in outlining the desired notion or mental image to be formed about each of them. It would, therefore, be wise to continue this practice. However, for economy and convenience, some of them, specially the terms and facts having fixed meanings may be written as it is. Even the techniques (procedures), processes, and classifications may be outlined by their names, preferably with their major steps or classes. But the concepts, principles, generalizations, themes and structures should be outlined invariably in the form

of concepts delimiting the response. This helps in better concept formation by the pupils.

. A tabular presentation of the content-analysis for : unit / organised sub-unit or topic-wise makes it handy, more recommendable, clear and meaningful to both teachers as well as pupils (Table -1).

(For Table , page 3.13)

TABLE 1 : CONTENT ANALYSIS OF A UNIT

Name of the Unit: FLOWER STRUCTURE AND FUNCTION
Class: IX DURATION: 4 periods of 30-35 minutes each

Sub-units	Topics	Facts	Procedures/ Techniques	Exercises	Classification	Concepts, Principles, Generaliza- tions
1. <u>Parts of a flower</u>	1. Petal, sepals, corolla, androecium, gynoecium, pistil, anther, filament, pollen, connective, stamens, ovary, ovule, in flower, cross-section, perianth, bisexual and bisexual flowers, monocous and Dicotylous plants, receptacle, etc.	1. Papaya plants bear either male or female flowers. 2. A maize plant bears both male and female flowers. 3. A maize plant bears both male and female flowers. 4. A banana tree bears flowers enclosed in a fleshy receptacle.	1. Technique of dissecting a flower 2. Use of a dissecting microscope 3. Observation of flowers and their parts with hand lens. 4. Recording of observations graphically as well as verbally		1. All flowers of a particular plant are similar in structure 2. Some plants bear two types of flowers borne on the same plant or on different plants 3. Flowers of all plants are basically similar in structure	

1	2	3	4	5	6	7
2. <u>Pollination</u>	Pollination, Self and cross pollination, anemophily, hydrophily, entomophily, zoophily	1. Floral, banyan and fig flowers are pollinated by insects.	1. Observation of flowers and their parts with hand lens	Process of Self-pollination, Cross pollination by wind, water, insects and animals.	Classification of plants on the basis of the type of pollination.	1. Plants and animals are dependent on each other.
3. <u>Fertilization</u>	ovine, intine, 1. Pollen fertilization male and female gametes, pollen tube, male nucleus, generative cell, micro-pyle, integument, nucellus, chalazae, hilum, raphe, embryo-sac, egg, definitive nucleus, 3. Male and female gametes, nuclei fuse to form the double fertilization, zygote, embryo, syncytium, antipodal cells.	1. Pollen grain germinates to produce male nuclei. 2. Ovule contains an egg and a definitive nucleus. 3. Male and female gametes, nuclei fuse to form the double fertilization, zygote, embryo, syncytium, antipodal cells.	1. Use of a microscope 2. Preparation of slides to observe structure of pollen grains. 3. Study of prepared slides to show structure of ovule and process of fertilization. 4. Recording of observation microscopically as well as verbal.	1. germination of pollen grains. 2. fusion of male and female gametes. 3. double fertilization.	1. Stigma of the flowers is well suited to receive pollens and induce their germination. 3. Double fertilization in Angiosperms is an adaptation to allow growth of the embryo in adverse environmental conditions.	

CHAPTER 4

FORMULATION OF INSTRUCTIONAL OBJECTIVES

J.P. AGARWAL
D.M. L. & D.P.

The instructional objectives express the desired changes to be brought about in a pupil's behaviour as a result of the instructional programme. In other words, they guide and control the entire teaching learning process to ensure steady growth in the desired direction. This demands a proper formulation of instructional objectives after having considered the needs and aspirations of the society, maturation level of pupils and their needs and aspirations, nature of the discipline, and the resources available. Therefore, the instructional objectives are to be carefully selected, and stated at appropriate level of generality tagged with related content elements.

1.0 BASIC PRINCIPLES FOR SELECTING OBJECTIVES

The following criteria or principles may be observed while selecting educational objectives for a specific course at particular level of education in order to avoid an unwieldy list of educational objectives.

1.1 Worthwhileness and Significance

An objective should be worthwhile; it should state a significant behaviour with reference to an important and socially desirable aspect of learning.

1.2 Attainability and Practicability

It should be attainable well within the means of the teacher i.e., teaching facilities, pupils' maturation level and teachers' competence.

1.3 Measurability and Predictability

The educational objective, as far as possible, may be assessed using the tools and techniques of evaluation with reasonable accuracy; in other words valid and reliable assessments may be made to ascertain the effectiveness of teaching as well as the desired change in the behaviour of pupils. In fact, it should predict a pupil's behaviour

1.4 Challenging Nature and Principle of Flexibility

The objective should be challenging enough to a pupil to motivate him or her to learn. As there are individual differences within a class, it would be advisable to maintain flexibility to accommodate all.

1.5 Comprehensiveness and Conformity to National Priorities

The objectives when considered together should cover all areas of learning - intellectual, emotional, physical and social. It is another thing that some of the objectives may need special tools and techniques for measurement. Each subject should cover the optional range of objectives covering all aspects of pupil growth. Thus, objectives of

each subject may lead to fulfil national priorities and in this way pave the way for accomplishment of National Goals of education.

1.6 Level of generality

The objective should be framed at the desired level of generality so that it directs pupil growth explicitly. It should be neither be too general nor too specific. It must spell out the purpose for which intended.

1.7 Non Composite nature of objectives

An objective should include only one type of objective with one or more but related areas of content. Two objectives should not be combined together to avoid overlapping and confusion.

1.8 Repetition, overlapping and contradiction

The list of objectives so developed should be free from repetition, overlapping and contradiction. This would also shorten the list and make handy avoiding to become unwieldy list of objectives.

1.9 Principle of continuity and togetherness

The objectives should be organised in a suitable system of classification in order to ensure a steady and continuous growth of pupils in various aspects of human learning. This would also bring similar objectives together avoiding scattering of them.

2.0 Guidelines for stating educational objectives

Educational objectives are the intentions to be accomplished as a result of educational programme. These intentions should be expressed in such a way that they carry

the direction effectively. Following are the suggestions which may be observed while stating and formulating objectives. These are in continuation of the basic principles of selecting objectives and so these principles are inclusive.

2.1 The objectives are statements and so should be written in complete sentences involving both behaviour component as well as the content.

2.2 The objectives are stated at various levels of education and so level of generality may be maintained accordingly. Our primary concern is to state them at the subject level and then to unit and topic levels for developing instructional programme as well questions for the examination papers, unit tests and periodical tests. At all these three levels the behaviour part as well as the content part will gradually expand in terms of specificity. For example, at the subject level, an objective on understanding may state: "The pupil understands the various content elements related with science". This should be followed by specifications. (Refer Appendix I: List of Instructional Objectives). But at the unit level, the statements of instructional objectives are to be further made in more specific terms. For example, while stating an objective for the unit "Flower structure and Function", it may state as "The pupil understands that the flower structure is adapted to its functions". This should be followed by the desired specifications, i.e., the pupil compares certain flower parts classifies flowers into

categories on certain criteria, etc. at the topic level, the specifications would be more specific. For example, "the pupil compares the structure of stems belonging to different plants to state similarities and differences", "the pupil classifies flowers on the basis of free and fused calyx, free and fused petals and free and fused carpels" etc. Therefore, one can find an increasing amount of details, or in other words, specificity when we move from subject level to unit level or from the latter to the topic level. On the higher levels, e.g. state level or National level, the specificity decreases to make the list handy. Naturally at this stage, the generality in stating the objective would be maximum. Such statement of objectives may be seen in the reports of various Education Commissions including the 5-year plans (Refer Government of India, 1970; Education in the V 5-year Plan for National level objectives).

2.3 The statement of an objective should reflect the pupil's terminal behaviour instead of the teacher's intentions
the outcomes of learning instead of the learning process, and the pupil's performance instead of teacher's performance. All these three aspects are interlinked and further elaborated with the following examples.

- a) The pupil classifies flowers belonging to different plant species on the basis of stated criteria
(states terminal behaviour, outcome of learning and pupil's performance).

b) To enable pupil to classify flowers...

(states teacher's intentions or behaviour)

c) The pupil observes flower for classification

belonging to....(states process of learning)

d) The teacher explains the pupils how to classify flowers.....(states teacher's performance).

2.4 The instructional objectives should be written in a non-composite manner, i.e. two behaviours should not be combined together. "The pupil compares and classifies flowers ...", is a poorly stated objective. In fact, ability to classify is an higher ability than 'the ability to compare' and so it includes the lower ability in itself. Therefore, it would suffice to state, "the pupil classifies flowers....". This objective expects that pupil will identify, compare and classify.

2.5 Each objective is written at two levels. First at the category level of the objective, i.e., "the pupil understands the flower parts". Second at the specification level of the objective; in other words, a category of an objective is followed by one or more specifications, i.e., the pupil identifies relationship between flower parts and their functions, "the pupil classifies flowers belonging to different plant species on the basis of stated criteria", etc.

This involves the following three points:

2.5.1 Each objective is stated at two levels, one at the

objective's major category level, and this is expressed by more generalised behaviour, i.e. knows, understands, applies, draws, appreciates, develops interest in, etc. While the other is at the specification level which is expressed by more specific behaviours.

For example, under understanding objectives, by translates, identifies relationships, compares, classifies, etc.

2.5.2. The second level statements are to be arranged with the level of complexity under its respective category.

The two specifications i.e. 'the pupil identifies relationships between.....', and the pupil classifies.....', are to be placed one after the other under the category understanding having more generalized statement, i.e.

'the pupil understands.....' This system arranges objectives in an hierarchical order following the system of classification.

2.5.3 The objectives and specifications appear two different things. In fact, specifications are the objectives stated in specific behaviours which are attainable and measurable to the extent desired.

Examples, of these specific behaviours are: translates, compares, classifies, explains, etc. under the category

UNDERSTANDING. On the other hand the term objective is used for the category of objective, it is spelled out less specifically and can not be measured without its specifications. This is just like the binomial nomenclature in biology. An organism bears two names the former generic and the latter specific e.g. Homo sapiens. Similarly here each objective is stated with two statements one representing the category of the objective and the other its specific objective. The latter makes the real objective.

Objectives stated following these criteria are bound to be free from repetition, overlapping, contradiction, scattering and discontinuity, and at the same time, communicate the intent clearly, unambiguously and specifically

3.0 SELECTION AND STATEMENT OF OBJECTIVES FOR A UNIT

The instructional objectives to be accomplished by a unit are also selected and stated following the criteria mentioned in 1.0 and 2.0. This means selection of objectives appropriate for the unit covering all aspects of the personality and their statement at proper level of generality covering both behavioural aspect as well as the content element.

3.1 Selection of unit objectives

Only those objectives should be selected which are attainable and well within the realm of course objectives.

They should cover, as far as possible all aspects of pupil personality i.e., intellectual, emotional, physical, vocational and social.

3.2 Statement of unit objectives

An objective should be stated to clarify the intention of the teacher but in terms of pupil behavioural outcomes as suggested below. These are stated in the same tripartite manners.

3.2.1 State the objectives i.e. knowledge, understanding, application, skill, interest, appreciation, etc. While writing objectives state them in general terms using verbs like knows, understands, applies, develops skill in, appreciates, etc. using regular verbs laying emphasis on each pupil.

3.2.2 Write down the specifications (or abilities) under each objective in terms of behavioural outcomes. The specifications should represent the following:

- (a) A students' performance rather than a teacher's performance, e.g. The pupil detects error(s) in a given diagram of Datura flower.
- (b) Learning outcomes rather than the learning process, e.g. The pupil generalises that flowers of different plants have essentially a similar structure though they vary in details.

(c) terminal behaviour rather than the subject matter, e.g. The pupil translates the information given diagrammatically to a verbal form.

(d) only one ability rather than a number of abilities lumped together, e.g. The pupils cites examples of wind-pollinated flowers.

3.2.3 State the objective and the specification in a full statement rather than in the form of a phrase. It should consist of both, the directional word (or action verb) specifying the type of expected behaviour as well as the specific element of the content, e.g., the pupil identifies relationship between floral structure and its function.

3.2.4 The content elements, however, may be grouped together concerned with one objective or its specification for economy, clarity and organising teaching learning activities. For example, "The pupil cites examples of insect-pollinated flowers, pedicellate incomplete flowers, wind-pollinated sessile flowers, and the like".

3.2.5 When the content elements are presented in a tabular form, it is useful to outline the specifications grouped objective wise only by the behavioural words (or action verbs)

4.0 A LIST OF OBJECTIVES ON 'FLOWER STRUCTURE AND FUNCTION'

UNIT: Flower Structure and function

CLASS: IX

DURATION: 6 periods, each of 30-35 minutes.

1.0 The Pupil knows various content elements like terms, facts, processes, concepts, etc. related to flower structure, pollination; fertilisation and fruit and seed formation.

1.1 The pupil recognises various terms, facts, and concepts pertaining to structure and functions of flowers.

1.2 The pupil recalls various terms, facts, processes, concepts and generalisations related to flower structure, pollination, fertilisation and fruit and seed formation.

2.0 The Pupil understands terms, facts, procedures, classifications, processes, concepts, and generalizations related to flower, pollination and fertilisation.

2.1 The pupil translates information about the structure of a flower given in a diagrammatic form into verbal form and vice versa.

2.2 The pupil uses scientific terms in describing a flower.

2.3 The pupil cites examples of certain flower types, e.g. insect pollinated flowers, water pollinated flowers, pedicellate incomplete flowers, wind pollinated sessile flowers, etc.

2.4 The pupil identifies relationship between structures and their functions.

2.5 The pupil detects errors in statements and diagrams related with flower structure and function.

2.6 The pupil compares the following types:

- i) cross-pollination and artificial pollination
- ii) self pollination and cross pollination
- iii) wind pollinated and insect pollinated flowers
- iv) structure of a leafy shoot and a flower
- v) floral structure of Datura and china-rose.

2.7 The pupil classifies flowers on the basis of

- i) free and fused corolla
- ii) No. of carpels and type of fusion in them
- iii) Type of pollination including the agents used for pollination.
- iv) presence of bisexual and unisexual flowers.

2.8 The pupil interprets the following:

- i) flower is a modified shoot,
- ii) diagram showing process of fertilisation in a plant.

2.9 The pupil summarises the description of a Datura flower which is given in their textbook.

2.10 The pupil explains why certain flowers open only in the night.

3.0 The pupils applies facts, processes and concepts in novel situations

3.1 The pupil analyses the new structures in a given flower not studied by him/her earlier.

3.2 The pupil gives reasons why

- i) Certain insect pollinated flowers are scented but not brightly coloured.

- ii) Certain flowers open only in the night.

- 3.3 The pupil formulates hypothesis to explain
Pollination of a flower in certain species does not
affect fertilisation if transferred to the stigma
of the same flower.
- 3.4 The pupil suggests a procedure to test the hypothesis
formulated in 3.3.
- 3.5 The pupil concludes that
- i) all flowers are similar in basic structure and
functions.
 - ii) flowers are well adapted to their functions.
- 3.6 The pupil judgeth given facts related to flower
structure, pollination and fertilisation.
- 4.0 The pupil develops drawing and experimental skills
related to study of flower structure, pollination and
fertilisation.
- 4.1 The pupil makes drawing related to the structures of
flower and its parts faithfully and proportionately.
- 4.2 The pupil labels diagram appropriately.
- 4.3 The pupil dissects the flower to expose its parts
skillfully.
- 4.4 The pupil records observations systematically.
- 4.5 The pupil reports the results of his observations
accurately.

Note: Specifications on other objectives can also be drawn
on these lines.

CHAPTER 5

CHARACTERISTICS OF GOOD QUESTIONS AND THEIR VARIOUS FORMS

J.P. AGARWAL,
RAIPUR

1.0 IMPORTANCE AND IMPORTANCE OF QUESTIONS:

Teachers use questions in teaching for various purposes, i.e. for involving pupils' participations as well as to ascertain effectiveness of the teaching-learning programme. The written and oral examinations, too, use questions. That is why, there is a need to have sufficient know how and expertise in item writing, so that good questions may be framed for the purpose desired.

What is a question? A question is a request to the students to let the examiner know their behavioural outcome with reference to a particular ability and a specified area of content. In other words, a question is to seek evidence on behavioural changes brought about directly or indirectly through a well-planned instructional programme.

2.0 CHARACTERISTICS OF GOOD QUESTIONS:

Good question should invariably test the predetermined objective sampling the content appropriately and should be given in a simple unambiguously worded sentences, preferably interrogative. The length of the question should be calculated and controlled so that it is suitable for the estimated time and marks allotted.

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2.1 OBJECTIVE BASED TO TEST A SINGLE ABILITY :

A question should be framed on a single pre-determined objective stated in terms of behavioural outcomes and it should test the same effectively. However, an essay type question and, sometimes, even a short answer question may test more than one objective involving one or more specifications. This is usually more applicable for combining objectives with drawing skill. In all other cases, as far as possible, questions testing a single objective should be based on a single specification.

2.2 EXACT SAMPLING AND MAXIMUM COVERAGE OF CONTENT :

The content of a question is closely related to the objective being tested. The question-framer has, therefore, to take into account the topic or the sub-topic he is going to test as well as the teaching learning activities, possibly organised. He should see that the questions sample exactly the same area of content which he wanted to test. Further, he should try to cover maximum content spread over the entire unit or a few related units. In a unit test, it may sample content of the sub-units, as much as possible.

2.3 SUITABLE FORM OF QUESTION :

Essay type, short-answer and very short answer types, and objective type questions are the main forms of questions which are in use. In a question the form depends considerably on the kind of ability as well as the content to be tested. Some forms are more suitable than others in testing certain abilities.

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Essay type questions are more suited to test abilities demanding organisation, expression and integration of ideas, as well as lengthy argumentation and interpretations etc. Therefore, a judicious use of appropriate form of question will have to be made while setting questions.

2.4 USE OF CLEAR AND SIMPLE LANGUAGE:

To bring objectivity in evaluation, there is a need of using simple clear, precise and unambiguous language while framing questions. Use of unfamiliar and difficult terminology may be avoided so that the comprehension of the question may not become a problem to the students. By and large all students may make the same meaning out of it. Here special care may be taken in using directional words. Use of "Write short notes on", "Write an account of", "What do you know about", etc. may be avoided because such words create difficulty in understanding the exact scope of the expected answer on the part of the examinees. The question should be in the form of a full sentence (or more) and may be a simple sentence or interrogative one. The latter is considered better as it puts the task straight forwarding.

2.5 PROVIDING A PROPER SITUATION FOR TESTING:

In writing item, selection of appropriate situation is an important step in the framing of questions. Textbook situation is alright in testing knowledge. Other situations discussed in the class may be suitable to test knowledge or understanding. But to test application of knowledge, some new situations have to be provided. Although in such cases, situations go beyond the

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the text-book yet they should be well within the maturation level of pupils. It will be advisable if the teacher collects such situations and keeps a record of them so that they may be available as and when the need arises.

2.6 SET FOR SUITABLE DIFFICULTY LEVEL:

While writing a question the setter should be conscious of the difficulty level of the question in relation to the ability level of question usually depends upon the complexity of mental processes involved, the area of the content to be tested and the time available to answer it. It can be estimated fairly well. Actual difficulty indeed, of course, is obtained only after the question is really tried out and analysed. A general recommendation is to frame questions with difficulty level ranging from 20% to 80%; a difficulty level of 50% is considered the best, why? Because it offers highest possible discrimination.

2.7 OFFERING OF IDEAL DISCRIMINATION:

It is not possible to estimate the discriminative value of a question unless it is tried out. Nevertheless when some novel situations are involved and common place questions are avoided, the questions definitely go a long way in discriminating bright students from the poor ones. Questions at either extreme of the difficulty continuum are poor discriminators, while those in the middle have been found to be good in this respect. It is, therefore, expected that questions should be set at different difficulty levels providing optimum to maximum discriminations.

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2.8 STRUCTURED FOR THE SCOPE OF ANSWER:

The item-writer should see that while framing a question he gives some thought to the expected answer. He may prefer to even write the answer. That would sometimes reveal the weaknesses in the question itself. It is structured to specify the length and scope of the expected answer. It is advisable to indicate the length of the expected answer in the question itself.

2.9 PROVIDING MARKING SCHEME AND SCORING KEY:

In case of objective type questions, the scoring key must be prepared alongwith the questions. In case of essay type, outline answers are to be written indicating clearly the weightage to each value point in terms of marks while for short-answer and very short answer full expected answers should be prepared. The marking scheme so formed should be acceptable to all informed subject experts. The distribution of marks over the question increases the reliability in scoring.

A setter, therefore, while constructing a question, should be conscious of the various dimensions of questions discussed above as also the other considerations peculiar to a particular form of the question.

3.0 DIFFERENT FORMS OF QUESTIONS:

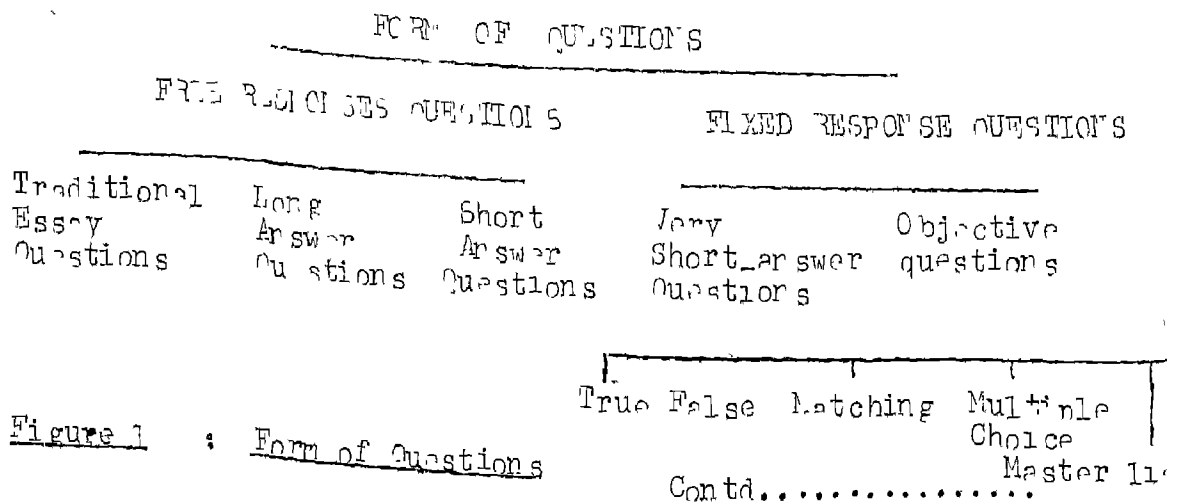
It has already been mentioned that depending upon the objective and content, we may select essay type, short answer, very short-answer or objective type question to test a particular learning outcome. Most commonly used tools of evaluation are the

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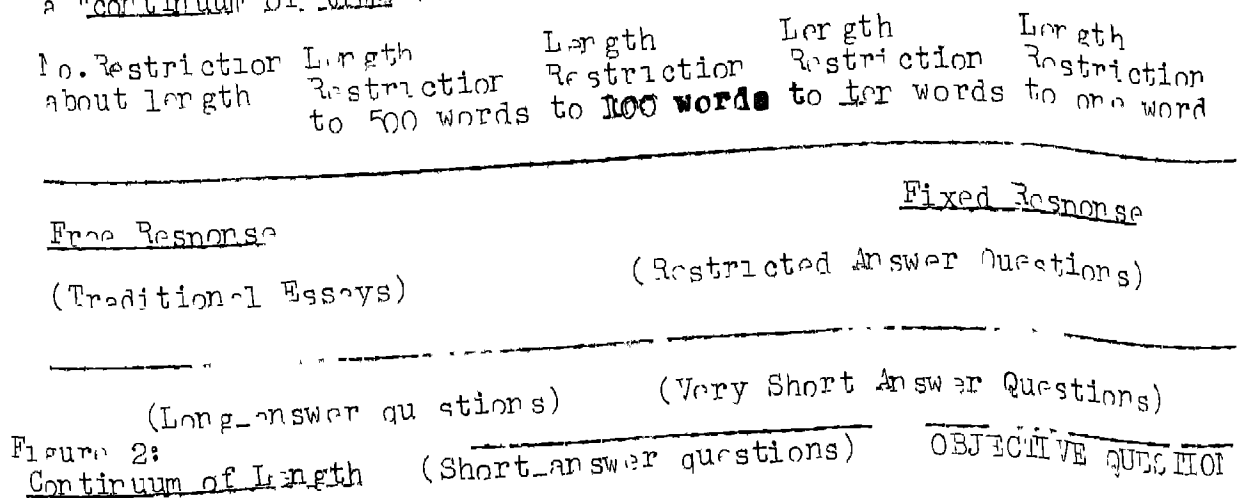
written tests which generally use "free response" type of questions. Essay type questions come under this category. The Short_answer questions are also classified as free_response questions but in them response is restricted from moderate to a very large extent. It is, therefore, desirable to call them "restricted_response" questions. The other two types, i.e. very Short_answer and objective questions due to having "fixed" or "almost fixed" responses are called 'Fixed response questions.

The present-day essay questions are now, no longer, essay questions in the sense they have been deprived off of the characteristics which traditional essay questions had enjoyed in the past i.e. no restriction in length or scope except the time constraint on the part of the examinee. This type of 'open-ended' nature is now not allowed. Moreover, the scope of the answer as well as style of presentation are also set in present-day essay questions. It would, therefore, be better to call them "Long_answer" or "extended answer" questions.

The various forms of questions as usually classified are given in figure 1.



Essay question (traditional essay or long-answer), short-answer questions and very short answer questions are often grouped together as "supply-type" questions because to attempt them, the examinee supply the answer. On the other hand, the objective questions are classified as "selection-type" questions as in them, examinee selected the most appropriate answer from among a limited number of alternatives already given in the question itself. The supply type questions, as discussed earlier, are differentiated in various types simply on the basis of the length of the expected answer or the value-points involved in answering them. Both of these aspects are related to each other and also with estimated time for reading the questions, comprehending the task, thinking for the appropriate answer, writing the answer and reviewing it. Thus, basically the classification of supply type questions is on the basis of the length of the expected answer, but it is a relative expression and can not be fixed in absolute terms. In fact, their classification can better be understood by a "continuum of length" (figure 2) or a "continuum of time".



Objective questions are selection type questions of fixed response variety. These are further classified in a number of forms, i. e. True-False, Matching, Multiple-Choice, Analogy type, Terminology type, completion type, classification type, etc. It would be interesting to know that the Very Short answer questions do have some of these types, namely Analogy type, Terminology type, completion type, etc. But these types under Very Short answer form involve supply of answer instead of selecting of an appropriate answer from among already given alternatives.

Familiarity with different forms of question is a pre-requisite for framing good questions. Therefore, item-writers should collect sufficient information on various forms of questions and their sub-categories as well as how to construct and improve them.

6.1 :-

6.1 :-

CHAPTER 6

LONG ANSWER OR ESSAY TYPE QUESTIONS:

J.I. MC RUAL
READER

This is the most prevalent and most abused variety of questions. In fact, it is still in use with certain modifications because it tests certain very important abilities not tested by any other form of questions.

1.0 CHARACTERISTICS OF LONG ANSWER QUESTIONS:

A long answer or essay type question (often abbreviated to LA or ET) is one where the response to a question is extended free response (or an open ended answer). The examinees will have to supply this answer. There is no single correct response but the accuracy of the subject matter selected and the suitability of the style used can be judged by a person who knows the subject. These questions require the candidate to select relevant content, organise them coherently and express concisely in his own words. They generally open with such words as 'Explain', 'Describe', 'Interpret', 'Compare', 'Discuss', etc. These words are known as directional words or action verbs. However, its scope should not be totally unrestricted. It should be controlled to include about 5 to 10 value points, with estimated time of 10-20 mins. and allocation of marks 4 to 10 depending upon maximum marks and total duration of the question paper. The length of the answer can be recommended for such questions to range from 50 to 200 words.

2.0 MERITS AND DEMERITS OF LONG ANSWER QUESTIONS:

Essay type tests have been repeatedly criticised by these

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who are interested in the scientific measurement of achievement but little effort has been made to improve their reliability in spite of the fact that they are widely used by classroom teachers. If properly constructed, they can measure important outcomes of learning which can not be measured otherwise. For example, a long-answer question tests abilities to select appropriate ideas adequately, organise them coherently, and integrate ideas succinctly. In other words questions demanding argumentation, summarisation, creativeness and sustained discussions can only be framed by this type. To certain extent, even the attitudes, values and ability may be known held by the examinees through essay questions.

The essay (or long answer) questions are said easy to frame and administer. But, in fact, to set good objective based essay questions need a lot of time, thinking and labour on the part of the examiner. The scoring of these questions is also time-consuming, subjective and variable. An answer offers content with varying degree of correctness, organisation with varying degree of coherence, and expression with varying degree of succinctness. Due to these three variables, the judgement of the examiner becomes variable, troublesome and time-consuming. The marking scheme offers aid to various value points but does not reduce the task of decision marking on these value points but does not reduce the task of decision marking on these three variables. This leads to unreliability in scoring the answer-scripts.

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Unreliability of the test also increases as the essay questions sample the content poorly. The content coverage is confined to a few topics only, and thus, leads to selected studies and guess work. This also reduces content validity of the test. Moreover, examinees prefer to bluff the examiners by adding worthless material, just to increase the length of the answer. A careless examiner may not detect this, and so scores awarded are likely to be unreliable. Carelessness, on the part of the paper setter, also adds to unreliability. It is, therefore, need to set the task in the question explicitly and also structure the question for the length of the answer as well as for style of presentation.

3.0 GUIDELINES FOR CONSTRUCTING LONG ANSWER QUESTIONS:

Long answer questions when constructed properly may serve to test certain higher abilities with reasonable reliability provided the answers are marked following the marking scheme strictly.

3.1 Essay questions should be set to test only those instructional objectives which are not amenable to testing by other forms.

3.2 Each question should be based to test specific instructional objectives or significant learning outcomes.

3.3 Frame questions in such a way that their meaning and intent are clear to the examinees. In other words, the language should be simple, easy, precise and unambiguous.

3.4 Structure questions to guide on the scope and length of content on one hand and the style of presenting the expected

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6.4 :-

answer on the other. By this all examinees may get the task almost similarly and respond accordingly. This increases the reliability of the test.

3.5. Directional words like, 'what do you know of', 'give an account', 'write short notes on' etc., may be avoided because they create difficulty in understanding the exact scope of the answer. Instead of them, use proper and exactly worded directional words to set the style of answer explicitly. Use of directional words like state, explain, discuss, give reasons, justify, interpret, classify, judge, illustrate, etc. is recommended.

Maturation level of the examinees must be taken into consideration while constructing an essay question. Length and nature of answer will differ from class to class. For example, questions requiring discussion, interpretation, summarisation, or judgement may be asked in higher classes whereas those like listing, describing, stating reasons, etc. may be used for junior classes.

3.6 Marks should be clearly allocated part-wise whenever there are more than one parts in the same question.

3.7 A question should force examinations to sample a wider content in order to select, organise and integrate information. This increases better coverage of course content and so increases the reliability of the test. Students are also forced to go through the entire content.

3.8 Prepare the model answer and review the questions in the light of the instructional objective being tested, content of the
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question desired, style of response expected, time required and marks allocated. Modify the question accordingly.

3.9 Prepare detailed marking scheme. All significant credit points should be mentioned clearly. Usually one credit point should be of one mark; sometime of one-half. Allocate marks on each credit point. Marking on specific credit points is found to give a more reliable score than marking on the basis of overall impression with respect to a question.

Similarly marking answers question-wise also increases reliability.

Reliability of essay examination can also be improved if the students are trained properly for how to attempt essay questions through the use of improved variety of essay questions is day to day testing. They need to be familiarise with the method of attempting such questions in accordance with the connotation of the various words, specially the directional words used to circumscribe the nature and scope of the expected answer. This will ensure to a greater extent, the consistency in each student's understanding of what he is required to write in response to a particular question and the way the teacher is going to grade it.

4.0 EXAMPLES OF LONG ANSWER QUESTIONS:

A few long-answer questions, set for certain unit tests are given here alongwith question-wise analysis. These may be examined critically after having prepared a detailed marking scheme for them. This would provide an experience in working as item-critic as well as an item-writer.

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4.1 EXAMILES:

- Q.1 Give a comparative accounts of isolecithal and telolecithal eggs in a tabular form to reveal two significant similarities and four differences between the two. No diagram is required (2 + 4)
- Q.2 State the role of light energy on photosynthetic process in about 200 words. (5 + 3)
- Q.3 In an O_2 - evaluation experiment using live Hydrilla twigs, it was found after an hour of setting the apparatus that no photosynthesis is going on in the plant. What may be the possible reasons for this? State any four. (4 x 1½ = 6)
- Q.4 Prepare a hand.out in about 150 words on "economic importance of forest trees" under the heads timber, paper industry and medicinal uses. Give two technical names in each case.

(2 + 2 + 2)

4.2 QUESTION WISE ANALYSIS

Sl. No.	Objective	Specification	name of unit	Marks allocated	Est. time mts.	Difficulty level
1.	Understanding	Compares	Developmental biology	6	15	Average
2.	Understanding	explains	Physiology	6	15	Average
3.	Analysis	analysis	Physiology	6	15	Difficult
4.	Knowledge	recalls	Biology and Human Welfare	6	15	Easy

CHAPTER 7SHORT ANSWER QUESTIONSJ.P. AGARWAL
READER

Long-answer or essay type questions suffer from lack of reliability in scoring while fixed answer type items are often inadequate to test certain aspects of pupil growth, i.e. organisation and expression of ideas. Short answer questions are a good via-media between these two extremes and serve a useful purpose in testing pupil achievement with reasonable reliability and content validity, provided these are constructed properly. Such questions are useful for both external and internal examinations.

1.0 CHARACTERISTICS OF SHORT ANSWER QUESTIONS:

A short-answer question (often abbreviated to SA) is a supply type question in which scope of the response and style of presentation are specified to a quite good extent by the item-writer. However, there is no clear-cut demarcation about the length of the answer between long-answer and short-answer on one hand, and between Short-answer and Very short answer on the other. Figure 1 expresses the range in length of these various forms of questions on a continuum of length. However, range in length is also governed similarly by the value points involved, estimated time allocated for attempting the question, and marks allotted. The class and the maturation level of pupils for whom a short answer question is written are also important factors in deciding the scope of the answer. In general, for Senior Secondary classes a short-answer question may involve 2 to 6 value points

2.2 :-

with estimated time 4 to 10 minutes and allocation of marks 2 to 4 depending upon the class level and maturation level of the examinee for whom the question is written. Such questions may have a length of expected answer in between 10 and 50 words.

2.0 MERITS OF SHORT ANSWER QUESTIONS:

Short answer questions have emerged to overcome weakness of both essay type and objective type questions. The following are its favourable aspects.

2.1 Short answer questions take much less time in framing than the objective test items. In this way they are like to essay type questions.

2.2 Short answer questions have overcome some of the defect of essay type questions; they are better structured for the scope of the answer and thus can be marked more reliably. The "guessing aspect" often prevalent in essay questions is overcome in this variety to a very large extent.

2.3 Scoring in short answer questions is much easier to essay type questions as only a few credit points are to be examined at time. This increases the reliability in scoring and reduces the subjectivity significantly.

2.4 The essay questions sample the content quite poorly while when short answer questions are used, the number of questions also increase coverage, and thereby an increase in content validity.

2.5 The short answer questions can retain the usefulness of essay questions provided these are properly constructed. A good short answer question can test most of the specifications of various categories of objectives and also the selection, organisation and expression to a limited extent. However, it is not good to use them for testing factual information for which VSA and objective questions are more suitable.

3.0 DETAILS OF SHORT ANSWER QUESTIONS:

Short answer questions, like any other form of questions also suffer with certain weaknesses as stated here.

3.1 The short answer questions are less effective when compared to essay questions in testing selection, organisation and integration of data, ideas and prolonged argumentation.

3.2 The subjectivity at the scoring level remains to a good extent, though less than that creeping in scoring of essays. It is, however minimised by developing appropriate marking scheme and following them strictly.

3.3 The course coverage is not as great as is possible to cover with the use of very short answer questions and objective test items.

4.0 GUIDELINES FOR CONSTRUCTING SA QUESTIONS:

The construction of short answer questions is not much complex but use of guidelines properly help in setting good questions.

4.1 Selection to test appropriate abilities:

This form of questions should be selected to test objectives which are most amenable to this form. For testing prolonged argumentation or lengthy discussions, this variety may not be used. All other type of objectives can be tested by SA questions.

4.2 Single objective based:

It should be framed to test only one specification involving 4-6 value points only. Two or more specifications should not be combined usually.

4.3 Language of the question:

The sentence(s) of the question should be constructed in such a way that the task is conveyed clearly to all pupils. They receive almost similarly. For this purpose difficult words should be avoided. In other words the level of language of the pupils should find place in the questions. Clarity and unambiguity in the language of the questions must be maintained.

4.4 Content Sampling:

The question may be framed to force examinees to select material for the answer from among the entire unit or sometimes from two or more units. This increases the course coverage and thereby content validity, and difficulty level of the questions.

4.5 Scope of the answer:

The question may be structured to guide over the length and style of the expected answer which can be attempted within the estimated time. The item writer may visualize all the four factors

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involved while deciding the scope of the expected response i.e., allocation of marks, estimated time and number of credit points, This again depends on pupils' maturation level and the class for which a test question is being constructed.

4.6 Use of Directional words:

Suitable directional words, which convey the task meaning fully and successfully to all, should be used. This is desired so that the pupil may get the task in the same way as it is intended by the item-writer. It would be better if the pupils are allowed to familiarize with these directional words alongwith their meaning. Some of the commonly used directional words for short answer questions: State, justify, explain, give similarities or differences, judge, etc. Avoid use of heavy words like discuss, compare and contrast, comment, write short notes, what do you say etc. The scope of the response and/or require lengthy answers.

4.7 Distribution of marks over the parts:

Generally a short answer question should not have more than one part. However, if there are parts, the distribution of marks over the various parts should be indicated appropriately on the right side of the question.

4.8 Preparation of the marking scheme:

While developing the question, the marking scheme should be prepared. This helps in reviewing the question for the proper use of the directional word, ambiguity in the language of the question, and the exact scope of the expected answer. This also

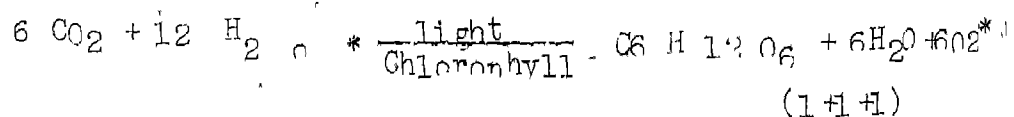
helps how much time would be required by an examinee in attempting it. Besides these, it is required to value the answer scripts. While preparing the marking scheme each value point should be fully stated along with marks allotted.

5.0 EXAMPLES OF SHORT ANSWER QUESTIONS:

Below are a few examples given here to guide the item writers in preparing and marking points of a short answer question. It would be useful to prepare the expected answer for each question and then judge it on the guidelines suggested in this paper so that its construction is proved to convey the task efficiently and effectively as well as to mark the answers reliably.

5.1 EXAMPLES:

Q.1 Express in your own words what does the following equation demonstrate.



Q.2 In a mercury tube experiment on anaerobic respiration using gram seeds, a student failed to get CO_2 evolution.

List any two possible reasons which could explain this failure.

(1 + 1)

Q.3 "The recent Bhopal disaster caused by MIC leakage represents our madrush for the production of insecticides." Give only two arguments to oppose this statement.

(1 + 1)

- Q.4 What would be the effect on human life, if the crowded industrial cities are deprived of plants altogether? State only the most significant aspect in about 50 words.

(1 + 5)

5.2 STATISTICAL ANALYSIS OF S.A. QUESTIONS:

(Higher Secondary Level)				
Sl. No.	Objective and Content unit specification	Marks allotted	Estimated time	Estimated difficulty level
1.	U-translates Physiology	3	5	Average
2.	A-hypothesizes Physiology	3	5	Difficult
3.	A-judges Biology and Human Welfare	3	5	Difficult
4.	A-predicts do.	3	5	Difficult

CHAPTER 8VERY SHORT ANSWER QUESTIONS

J.P. Agarwal,
Reader

Objective type questions and very short answer questions are often grouped together under the term "fixed answer questions" because in them, the answer is more or less fixed by the item-writers at the time of setting the questions. Some authors like to keep the latter category, i.e. the very short answer questions under the objective questions which is not correct due to two major reasons. Objectives questions are, in fact, characterised by being free from subjectivity at the time of their scoring. Moreover, these questions are of "selection type" that means that examinees will have to select the correct or most appropriate answer from among a limited number of alternatives. On these two aspects the very Short answer questions are different from the objective questions.

Scoring of very short answer questions is partly objective and partly subjective as there is a possibility of subjective judgement. The answer supplied by a candidate may be correct but 'incomplete' or 'mis-spelt' or with additional irrelevant material. In such situations, the opinion of the examiners may vary, and even the same examiner may have different opinion on two different occasions. Thus, Scoring of very Short answer questions involves a "decision making" and so becomes partly subjective.

8.3.

short answer category, a compensation of this extra-consumption of time must be made elsewhere, preferably within the category of very short answer type question itself.

Examples:

- Q.1. What is name of the person who discovered the law of segregation? (K-recalls fact; ans. Gregor Mendel)
- Q.2. Name any one characteristic which is present in rhizome of ginger and root-tubers of sweet potato but absent in potato tubers.
(U-compares; Ans; Presence of roots in the former two but lacking in potato tubers)

2.0. MERITS OF V S A QUESTIONS:

Very short Answer questions have a number of advantages over other forms of questions.

- 2.1. VSA questions measure pupil achievements much more validly and reliably than Essay and short-answer type questions. This is mainly because due to them the course coverage and number of questions are greatly increased, scope of the answer is explicitly made clear, bluffing and guessing in attempting questions is minimised and scoring is done almost always objectively involving almost nil subjectivity. The Halo effect" is almost completely Nil.

8.4.

- 2.2. Preparation of V.S.A. question is much easier than any other form of questions. Even their administration and scoring can be done quickly with much ease; on this point, they almost approach objective type questions.
- 2.3. V.S.A. questions are useful in testing a wide variety of educational objectives except those demanding Selection, organisation and integration of ideas. In this respect they are like those of objective type of questions.
- 2.4. V.S.A. questions retain most of the merits of objective type questions. They are even advantageous over them in that they require much less space in the question paper and that they are prepared with much ease. Some of the abilities not usually tested by objective questions, are easily, tested by VSA question, e.g. ability to balance chemical equations.

3.C. DEMIRTS CF V.S.A. QUESTIONS:

Very short answer questions have certain limitations like any other forms of question.

- 3.1. V.S.A. questions are not useful to test certain higher abilities. Like objective type questions, they, too, can not test abilities to select appropriate ideas, organise them coherently and integrate them succinctly. These abilities are, in fact, measured by Essay or Long answer type question and to some extent by short answer questions.

3.5.

3.2. Some abilities tested by objective questions are also not easily measurable with the use of V.S.A. questions. For example, ability to make hypothesis, to propose certain steps of an experimental procedure to test a hypothesis, or to express judgement with reason on a statement is not so easily tested as is done by objective type as well as short answer questions.

4.c. FORMS OF V.S.A. QUESTIONS :

There are several forms of V.S.A. questions. More important ones are stated here.

4.1. Statement and question forms of V.S.A. questions:

In these forms of V.S.A. questions, the problem is presented by an imperative or interrogative sentence; the latter is better and also more frequently used, (Refer 1.1 and 2). Sometimes, the problem needs more than one sentence (Refer 1.3).

Q.3. In a thistle funnel experiment to demonstrate osmosis 2% starch solution was taken in the thistle funnel while 10% sugar solution was filled in the beaker. The process of osmosis was allowed to continue for about an hour. What would happen to the level of sugar solution in the thistle funnel ?
(A-analyses; Ans. The level of sugar solution in the thistle funnel falls down; Question form).

4.2. Completion of fill in the blanks form of V.S.A. Questions

In this variety of V.S.A. questions, an incomplete statement is provided with a blank to be filled up by the use of an appropriate word, number symbol or phrase. (Refer Q.4)

Q.4. _____ CO_2 + _____ H_2O $\xrightarrow[\text{Chlorophyll}]{\text{Light}}$ $\text{C}_6\text{H}_{12}\text{O}_6 + 6\text{H}_2\text{O} + 6\text{O}_2$

(Unbalanced chemical equation; Ans. 6 and 12 respectively)

4.3. Terminology type of V.S.A. Questions:

In this form, a technical term is desired to be known to replace its description. Such questions are useful at the lower level (Refer Q.6 and 7).

Q.6. What technical term would you use for, instead of say "Lateral appendages of the leaf borne at its base"?

(K-recalls terms; Ans. Stipule).

Q.7. The technical term used to indicate a non-directional induced movement of curvature due to light is

(U-relates; Ans. Photenasty; this term is a sub-type of coelation form).

4.4. Analogy type V.S.A. Questions:-

Usually this is a sub-type of coelation forms of V.S.A. questions called separately by some item-writers due to its specific purpose. In this form, a set of two terms having a certain similarity is compared with another set of two terms of which one term is to be provided by the candidate.

8.7.

While attempting such questions, pupils will have to find out the relationship existing between the two terms of the first set and then on the basis of this relationship to supply a suitable term similar to one of the two terms of the second set (Refer Q.8 and 9)

Instructions:- Fill in the blank space a term satisfying the relationship as is present between the two terms given to the left of the sign:

Q.8. Phototropism: thermonasty: _____ Seismonasty
(U.-relates: Ans. Photonasty, therronasty, or nyctinasty)

Q.9 Phototropism : Photonasty:: _____ Chemonasty
(U- relates; Ans; chemotaxis.)

4.5. Assertion and Reason type V.3.4. Question:

In this form, the statement consists of two parts, one of them is a statement of a fact or happening while the other is the reason responsible for that happening. One of these two part is left vacant which is to be filled up by the examinee. This is, in fact a sub-type of completion form (Refer Q.10). Sometimes both parts are given but one or both of them are incorrect and the pupils asked to report this (Refer Q.11 and 12)

Q.10. Green Plants do not give out CO₂ in the day because of

(U- explains; Ans. Photosynthesis.)

8.9.

clear, easy, precise and unambiguous language, use of stereotyped language should be avoided in order to discourage rote memorization. Avoid to pick up sentence for framing VSA questions from the text books as don't help in testing understanding of the concept or call.

5.4. Structure the question to put on the scope and length of the answer so that examinee try to attempt it within the

restricted time. For V.S.A. questions, allocated time is minute, with one mark sometimes half a mark. In no case a value point should be reduced below half a mark to avoid unnecessary inconvenience in scoring and totaling the marks.

5.5. Leave only one blank of uniform size, preferably towards the right side in completion type of V.S.A. questions.

5.6. Questions with common directions may be placed serially together under one set of directions. The directions should clear, about the length of the answers, allocation marks, and the procedure to indicate or write the answer.

5.7. Use the directional words carefully. Such directional words like state or reason, give one example, name or describe, balance or complete the chain of question find out relationship between, etc. are recommended. The meaning should be taken the same both by the examiner and the examinees. Directional words like discuss, write briefly, justify, what do you know about, write short note on, etc. are not suitable for V.S.A. question.

In this form of questions, the task is highly structured leading to only one almost fixed answer of one word, a phrase

8.10.

on a broad "net" basis.

8.8 Sampling of the content: Formulate V.S.A. question in such a way that it samples maximum content. This means that the content covered within the marks allocated should be collected. (Refer C.Hes. 2, 8 and 9).

8.9 Impose the Mark scheme below the question.

Advise the questioner with the light of construct and objectivity, and of content, the expected and the answer expected. This helps in the improvement of the question. There should be only one correct answer. If there are more than one expected answers, all of them should be coverable within the mark scheme. If required, use more qualifiers in the question so that it may lead to the same expected answer.

OBJECTIVE TYPE QUESTIONS

J.P. AGARWAL

M.A. Dutt

Objective questions (or test-items or items) are widely used by various agencies for a number of purposes. of pupil weaknesses, selection for admission or employment, assessment of pupil achievement for certificate examinations as well as for quality improvement in teaching etc. These are often preferred over all other forms of questions because they provide relevant information rather quickly. In fact, it does not take long to answer them and mark them. Teachers also find them useful for various purposes due to several reasons.

1.0. Meaning and Characteristics of Objective Questions

Objective questions are characterized by being scored objectively; this means that a response to a test item is either right or wrong. In judgment of these characteristics for the correct answer at the time of scoring. Objective test-items are structured for the scope of the response to such an extent that there is only one fool proof answer. In fact, an objective question involves a stimulus and a response consisting of either two alternatives, and that an examinee is expected to select the best or the correct alternative as his/her answer. Due to these characteristics an objective question is often qualified by terms like "fixed answer question" and "selection type question."

In an objective question, pupils will have to choose the correct answer by selecting the best answer or the correct answer. Therefore, separate answer sheets may be provided on which pupils may record their answers. This makes computing of these questions much easier and quicker and more interesting too. Even the scoring mechanism can be automated since answers can be checked without depending on the examiner's values.

Therefore, the characteristics of objective type questions are presented below; some of them distinguish them from all other forms of questions . . . Essay, short-answer and Very-short-answer questions.

- 1.1 Selection type questions with complete objectivity in scoring.
- 1.2 Highly structured for the expected response which is totally and fixed in advance; This includes then fixed response type questions.
- 1.2 Even question with two parts-a stimulus and a response; The stimulus consists of at least two alternatives, one of them is the fool-proof answer.
- 1.4 Objective based questions designed to test only one ability per question involving usually a value point, one mark and a restriction of one minute.

Example:

- Q.1 Which of the following characteristics will distinguish an objective question from all other forms of questions?

- A. (b) et v ty is t t i g but sub, et v ty is s e r i g.
- B. Supply type object v b e s e q u e s t i o n w i t h b j e t v ty
is s e r i g.
- C. S l e c t t y p e i n v o l v i n g a s u b j e c t v t y i n m a r k i n g.
- D. F r o m t h e p o s s i b l e w i t h b j e t v t y i s t t i g.
- (Note: Question form. fault ph-cha e; correct answer
type. U-compar s; KEY-C).

Direct for C.No.2 to 5.

Read carefully each of the following statements, If
the statement is true, circle the "T"; if the statement is
false, circle the "F".

- T F Q.2 It is a well established fact that all
parts of a green plant photosynthesize
during the day.
- T F Q.3 The graph of $x^2 + y^2 = 4$ is a circle.
- T F Q.4 One generates enough electric current to
light flashlight bulb by dipping two
strips of zinc into dilute sulphuric acid.
- T F Q.5 On the basis of solubility in water, the
chlorine and hydrochloric acid gases are
similar but differ from oxygen.

(Note: In each of the above questions, the statement is the
stimulus and T and F mark the response of two
different v e s; U-r l e t s, d o t e t c e r r o r o r c o m p a r s;
KEY: 2-F, 3-T, 4-F and 5-T).

Direct for C.No. 6 to 9:

In each of the following questions, the forms set of

two rows given in column I, or related by similarity in the use of stimulus or in the type of response involved (level and thickness of response). The relative appropriateness number of the term in column II, showing the relationship between the two terms, is placed to the left of the sign:

Column I (Stimulus & responses)	Column II (Responses)
Q.6 Phototaxis: Thigmotaxis : : Sensitivity :	1. Chemotaxis
Q.7 Phototaxis: Phototropism : : Chemotaxis : ?	2. Thigmotaxis
Q.8 Phototropism: Sensitivity : : Phototropism : ?	3. Thigmotaxis
Q.9 Chemotaxis: Phototaxis : : Geotropism : ?	4. Nutrient 5. Phototaxis 6. Hyponasty 7. Hydrotropism

(Note: U - comparison/extrapolation (?); Key: 6-3, 7-1, 8-5, 9-7).

2.0 Importance of Objective Questions:

Objective questions have several advantages over the traditional questions with certain limitations in their preparation and also in testing capabilities.

2.1 Utility of objective test-items:

These test-items test quite efficiently and effectively a wide variety of mental and objective including comparison and interpretation of data, elements and drawing conclusions and generalizations, establishing cause-effect relationships

and the level of difficulty, etc. How very many are unable to test selection, organization and expression of ideas which require open-minded appraisal. The validity and reliability of properly constructed tests are much higher than those of short-answer questions and about similar to very short-answer questions (with fixed response). This is mainly due to (1) better planning, (2) almost full coverage of the course content, (3) setting 100-150 test-items instead of 5 to 10 short questions in a 2-hour question paper, (4) structure of the test in accordance with a fool-proof pre-fixed answer, (5) learning to check off bluffing, and (6) using a project formula ($S=R-\frac{W}{n-1}$) to overcome the problem of guessing at the time of attempting questions.

Preparation of good tests is a difficult task but question-banks having a good store of tried-out items and facility of printing/cyclostyling test papers have solved this problem. Seeing if these question banks are free from subjectivity, bias, handy and much less time consuming than the selection machine to do this task mechanically. This has solved the problem of availability of good examiners and time consuming process of preparation of examination results having 2-70 lakhs examinees. Their use in almost all educational institutions is evident, by itself, of their popularity. In long run, use of objective questions will save not only time. Cost of paper and labour but also prove to be highly economical.

2.2. Disadvantages of Objective Questions:

Like V.O.I. question is objective test items, or also an appropriate test selection, organisation and expression of ideas which is tested easily by properly constructed open-ended questions. Besides this, it is also not easy to frame good items. In fact, it is a time-consuming tiresome task and needs intelligence, persistence and good knowledge of the subject and technique on the part of item-writers. Development of question banks is the only solution for this problem. There is also a problem of guessing on the part of examinees which, however, can be solved by using correction formula.

There are certain problems, though, of secondary nature but are very detrimental and affect the validity and reliability of these examinations adversely. These problems are related with techniques of examination including leakage of question papers, misplacement at the examination centres, specially, telling of the correct answers of the objective test-items, etc. These problems need specific attention.

3.0 Forms Of OBJECTIVE QUESTIONS:

There are several types of objective test items, i.e., multiple choice, true-false, matching, analogy type, classification form, etc. The Multiple-choice question is most widely used by test constructors as it can more effectively measure many of the simple and complex learning outcomes. Moreover, most of the various forms of objective test items can be set as multiple-choice items, and so only a few forms are stated here.

3.3. True-False or Alternative Response Questions:-

The true-false question is usually written in the form of a declarative statement which the pupil is asked to mark as true or false, yes or no, fact or opinion, agree or disagree, and the like. In such cases there are only two possible answers since the true-false option is the most common, this item type is frequently referred to "true-false item" (refer C.Nos 2-5). Some of the variations, however, deviate considerably from the simple true-false pattern and have their distinct characteristics. For this reason, the non-general category, alternative response item is preferred (under question number 10-14).

Examples:-

Directions for C.Nos 10-14

Read each of the following statements. If the statement is correct, circle 'F'. If the statement is a concept or generalization, circle the 'C'.

- | | | |
|----|----------|---------------------------------------------------------------------------|
| F | C Q.10 | Hydrilla gives out Oxygen during Photosynthesis. |
| F | Q.11 | Carbon dioxide given out by us during respiration turns lime water milky. |
| F | C Q.12 | Submerged aquatic plants or will adapt to live in the water. |
| F. | C Q.12. | Plants play a key role in maintaining O_2 - CO_2 balance in nature. |
| F. | C. Q.14. | Human skin is made of cells. |

(NOTE: U- compares; KEY : Q.10-F, Q.11-F, Q.12-C, Q.13-C, Q.14-F)

Matching items:

A matching exercise consists of two parallel columns (or lists) and the candidate is required to match correctly each word, number, symbol, phrase or even a sentence from one column with a word, number, symbol, phrase or sentence from the other column. The items in the column for which a match is sought are called premises (or stimulus term) and so, are assigned with question numbers. On the other hand the items in the column from which the selection is made are called response. The basis for matching responses to premises is sometimes self-evident but it is desirable to mention it in the directions. In such exercises, the task is to identify the pairs of items that are to be associated on the basis indicated (Refer question number 6-9 and 15-20). These questions are, sometimes, of specific forms e.g. analogy type (Q. Nos. 6-9), terminology type (Q. Nos. 15-17), or simple relationship type (Q. Nos. 18-20).

Direction: On the line given on left of each phrase in column I, write the number of the word in column II that best matches the phrase. Each word in column II may be used once, more than once, or not at all.

	<u>COLUMN I (PREMISES)</u>	<u>COLUMN II (RESPONSES)</u>
Q.15	Technical name of the lateral appendages of the leaf borne at its base	A. Phyllotaxy B2. Bracteole

COLUMN I (PREMISES)	COLUMN II (RESPONSES)
Q. 16 Mode of leaf arrangement on the stem.	C. Stipule
Q. 17 Term used for non-directional induced movements of curvature due to light.	D.4. Thalamus E.5. Photonasty F.6. Phototaxis
Q. 18 Leaf tendril	G.7. Lea
Q. 19 Stem tendril	H.8. Cocoloba
Q. 20 Phyllocade	I.9. Lemon J. 10. Australian Acacia, K. 11. Passion flower

(NOTE : There are two varieties of matching items in the above example; Q. No. 15-17 are 'terminology type' matching items while Q. nos. 8-20 are simple relationship type matching items.

U-relates; Key:

Q.-15-C, Q.16-A, Q. 17-E, Q. 18-G, Q.19-K
Q. 20-H).

This matching exercise illustrates an imperfect match as there are more terms in column II than are needed to match each phrase in column I. The directions also indicate that an item may be used once, more than once, or not at all. Both of these procedures prevent candidates from matching the final pair of items on the basis of elimination.

Two other factors are also notable for framing matching exercises. First, the items in the list of premises in column I should be homogeneous. The desired homogeneity can

be seen in the matching exercise given under 1.0 (Q. Nos. 6-9). In that case all the premises are concerned with one type of material only, i.e. different types of movements. This type of homogeneity is necessary if a matching exercise is to function properly. Secondly, for each premise in column I there should be several plausible responses in column II. Thus, the incorrect responses serve as attractive choices for those pupils who are in doubt about the correct answers. Both homogeneity of the material and plausibility of responses tend to minimise the opportunity for successful guessing.

The matching type is efficient in that the same set of responses can be used with a cluster of several similar stimulus words (or premises). But this is also a limitation since it is also a limitation since it is sometimes difficult to get a sufficient number of homogeneous premises to match a set of responses. Another limitation of the matching exercise is that it is restricted to test the ability to identify the relationship between two things. In fact, it measures factual information based on rote memorization. But, however, with the use of Analogy and terminology type matching exercise we can test comprehension quite efficiently.

3.3 Master-list items):

The master list item item (also known as classification exercise) is less familiar than the matching type but possibly more useful in specific situation (Refer Q Nos. 21-25).

Like the matching type, it uses a single set of responses but applies these to a large number of stimulus situations (In matching type the number of responses are more than those of stimulus terms.)

Direction: In the following items you are to express the effects of exercise on various body processes and substances. Assume that the organism under goes no change except those due to exercise. For each item encircle the answer A, B or C.

- A. If the effect of exercise is to definitely increase the quantity described in the item.
- B. If the effect of exercise is to definitely or decrease the quantity described in the item.
- C. If the exercise should have no appreciable effect

A B C Q. 21 Rate of heart beat

A B C Q. 22 Blood pressure

A B C Q. 23 Amount of glucose in blood

A B C Q. 24 Amount of residual air in the lungs

A B C Q. 25 Amount of white blood cells in the blood

(Note : A - predicts; key Q. 21-A, Q. 22-A, 23-B ,
24-B, Q. 25-C.

3.4 Multiple choice type Objective questions:

This is an important variety and needs more details, and so it is described in greater details under a separate chapter in order to discuss their characteristics, merits, and demerits and suggestions for their construction and improvement.

C H A P T E R - 10

MULTIPLE-CHOICE QUESTIONS

J. P. AGARWAL
READER

Multiple Choice type questions form most widely used variety for testing pupil achievement as well as for various other purposes like admissions, selections, etc. With the help of them a wide variety of objectives can be tested in a much shorter time than those of other forms of questions.

1.0 CHARACTERISTICS OF MULTIPLE CHOICE ITEMS:

Like other objective questions a multiple-choice item consists of a stimulus called Stem and a response having a list of suggested solution called alternatives. In the stem, the problem is stated in the form of a direct question (question form) or an incomplete statement (completion Form). The list of suggested solutions may include words, numbers, symbols, phrases, or full sentences which make the alternatives (or choices or options). The correct alternative in each item is called the Key (or answer), while the remaining alternatives are called distracters. These incorrect alternatives function to distract those examinees who are in doubt about the correct answer. Thus, like any other form of objective type questions, a multiple-choice item is selection type with a fixed fool-proof answer, complete objectivity in scoring and highly specified task.

10.2.

Directions for the candidates are carefully prepared to instruct them to read the task in the stem and list of alternatives to select the most appropriate answer (Refer Q. 1) or the correct answer (Refer Q. No. 2).

Example:

Q. 1 While selecting a city for a state capital, the factor which is given the most consideration, is

- A location.
- B highways.
- C climate.
- D population.

(Note: Best answer type, incomplete statement form of Multiple Choice item :
A-Judges; key-A)

2.2.0 ADVANTAGES OF MULTIPLE CHOICE QUESTIONS:

- 2.1 It can measure a variety of learning outcomes effectively and is adaptable to most types of subject matter.
- 2.2 The ambiguity and vagueness which frequently are present in the short-answer form are avoided because the alternatives provide greater structure to the situation.
- 2.3 Best-answer type multiple-choice items can be used to measure learning outcomes in several subject-

10.3

matter areas where solutions to problems are not clearly true or false but vary in degree of appropriateness (See Question no. 38 under 4-10). In such situations true-false items can not be used.

- 2.4 The reliability per item is greater than true-false item due to increased number of alternatives; the opportunity for guessing the correct answer is reduced proportionally.
- 2.5 It is free from response sets. That is, pupils do not have a tendency to favour a particular alternative when they do not know the answer.
- 2.6 The use of a number of plausible alternatives make the results amenable to diagnosis; factual errors and misunderstandings are known for correction.
- 3.0 LIMITATIONS OF MULTIPLE CHOICE QUESTIONS:
- 3.1 Like all other paper-pencil tests, it is also limited to learning outcomes at the verbal level. That is, it measures whether the candidate knows or understands what to do when confronted with a problem situation.
- 3.2 It is not well adapted to the measurement of some problem solving skills in mathematics and science and it is inappropriate for measuring the ability to organise and present ideas. This limitation is common to all types of selection items.

10.4

3.3 There is another limitation not common to other item-types. That is the difficulty of locating a sufficient number of plausible distracters. This difficulty diminishes considerably, however, by experience.

4.0 SUGGESTIONS FOR CONSTRUCTION:

The construction of multiple-choice test items involves the formulation of a clearly stated problem, the identification of plausible answers, and special efforts to remove irrelevant clauses to the answer. The following suggestions would be helpful for making effective use of this item form.

4.1 FORMAT:

4.1.1 Use Arabic numerals for numbering the item i.e.

1,2,3,4,

4.1.2 Leave a little space under the stem before writing the alternatives.

4.1.3 Leave a larger margin for writing the alternatives.

4.1.4 When the stem is in a question form, begin the alternatives with a capital letter, and put no sign of fullstop unless it is a full sentence.

4.1.5 When the stem is an incomplete statement, start each alternative with a small letter and end it by a fullstop.

4.1.6 Write all items with four alternatives only.

10.5.

- 4.1.7 Use Arabic numerals i.e. 1,2,3,4 or capital letters like A, B, C, D for numbering the alternatives with no brackets but a sign of fullstop may be used.
- 4.1.8 The correct answer should^{*} be placed in each of the alternatives positions approximately an equal number of items, but in random order.
- 4.1.9 Wherever the alternatives involve numbers only, arrange them in an ascending, or descending order.
- 4.1.10 Prepare a separate answer-sheet. Candidates should mark their answers by placing 'x' mark or by encircling the number. They should not be asked to record the answer by copying down the correct or by underlining it. Both question paper and the answer sheet should be taken back from the examinees when examination is over. When a separate answer sheet is not provided, specify the space for recording the answers.
- 4.1.11 Give clear instruction if penalty for wrong answer is to be given.

4.2 ITEMS:

- 4.2.1 The stem of the item should be meaningful by itself and should present a single, definite problem.
- 4.2.2 The item should include as much of the item as possible and should be free of irrelevant material.

10.6

Alternatives should not contain anything which could have been put in the stem.

4.2.3 State the problem in positive terms, as a general rule.

Words like no not least poorest etc. generally used in negative statements, should be avoided as they do not test important outcomes. In fact, in achievement testing we are usually interested in learning of the most important method, the principle which does apply, and the best reason.

4.2.4 Underline the words like 'not', 'best', 'except', 'least', etc. when used in the stem.

4.2.5 The text-book language should be avoided. Familiar or stereotyped phrases should not be used as the correct response but their use as distractors is preferred.

4.3 KEY:

4.3.1 Make the alternatives as brief as possible.

Brevity in the responses simplifies the task for the examinees. Brief responses also tend to focus attention on the essential differences among the alternatives offered. It also reduces the reading time required (Refer Q.38).

4.3.2 An item should contain only one correct or clearly best answer, admitting no difference of opinion among adequately informed experts.

4.3.3 All distracters should be attractive and plausible.

The purpose of the distractor is to distract the uninformed away from the correct answer. To the examinees who have not achieved the learning outcome being tested, the distractors should be attractive like the correct answer or even more. In fact, distractors should represent the common mistakes usually made by the examinees. And so, in a properly constructed item, each distractor will be selected by some people. An increase in homogeneity among the alternatives add to the plausibility of distractors as well as it increases the level of difficulty of the item.

4.3.4 The alternatives, if possible should cover a wider content, because good coverage of the course content is always expected in a test. Multiple-choice test items usually provide an extensive sampling of course content due to the large number of questions. This coverage can be better ensured if an item includes options from a fairly large but relevant sample.

Examples:

Q. 2 Relationship between cell and tissue is almost the same as between

- A Cell and organ.
- *B tissue and organ.
- C organ and organism.
- D tissue and system.

(Note: This item samples content from a single unit).

Q.2 (a) Relationship between cell and tissue is almost the same as between.

A nerve cell and brain.

*B erythrocyte and blood.

C epithelium and digestive system.

D neuron and xylem tissue,

(Note : This item sample several units of study).

4.3.5 The relative length of the alternatives should not provide a clue to the answer. Since the correct answer usually needs to be qualified, it tends to be longer than the distracters unless a special effort is made to control the relative length of the alternatives. Clever but poorly prepared examinees may guess the correct answer. It is desirable, therefore, to expand the distractors to the desired length by adding qualifiers to them. This process also adds to their plausibility as the distractors become more qualified and specific.

Examples:

..No.3 What is the major purpose of the United Nations?

*A To maintain peace among the peoples of the world

B To establish international law

C To provide military control

D To form new governments

(Note : The key is longest of all alternative)

Q. 3 (a) What is the major purpose of the United Nations?

- * A To maintain peace among the peoples of the world
- B To develop a new system of international law
- C To provide military control of nations which have recently attained their independence
- D To establish and maintain democratic forms of Government in newly formed nations.

(Note : The length of the key is made comparatively shorter by making some other alternatives longer).

4.3.6. Avoid the use of "all of the above" and "none of the above" unless their use is appropriate.

4.4 Irrelevant Clues:

Avoid all irrelevant clues to the correct answer.

- 4.4.1 Verbal association between the stem and the correct answer provides an obvious clue.
- 4.4.2 The greater details used in stating the correct answer (or even its greater length) than the distracters lead to the correct answer.
- 4.4.3 Grammatical inconsistency between the stem and the correct answer also leads to correct response.
- 4.4.4 Verbal stereotypes used as correct response provide an obvious clue.

4.4.5 The stem of one item may suggest the answer to another item.

4.5 GENERAL:

4.3.1 Write only about 20% items testing knowledge of terminology facts, principles, etc. and 80% testing higher mental abilities.

4.3.2 Control the difficulty level of the questions by modifying the problem in the stem and/or by changing alternatives.

4.3.3 After writing an item check up whether it is the best form in which it could be asked or whether it can be improved by- (a) changing some alternatives, (b) making the stem negative and reframing the alternatives, (c) interchanging the answer with the stem, and (d) bringing in more variables in the stem in order to frame more plausible alternatives.

4.3.4 Satisfy yourself fully that there is no room for any further improvement before passing an item as good question.

4.5 For QUESTION BANK:

4.5.1 Write the key of each item in the right hand corner at the end of the item.

4.5.2 Indicate the topic, the ability tested, and the expected difficulty level of each item at the top

(It is advisable the Item-writing sheets, developed by the N.C.E.R.T.)

- 4.5.3 Put all items on the same topic in one bunch.
- 4.5.4 Go through the lot on one topic once again and see if any more items on some other aspects worthy of being tested could be written. If so, write some more items and add them to the list, this process becomes easier if a thorough content analysis is done before beginning to write the items.

4.0 EXAMPLES OF QUESTIONS TO TEST KNOWLEDGE:

4. What principle is utilized in radar?
 - A Faint electronic radiations of far off objectives can be detected by super sensitive receivers.
 - * B High frequency radio waves are reflected by distant objects.
 - C All objects emit infrared rays, even in darkness.
 - D High frequency radio waves are not transmitted a like by all objects.

(Note : recognises the principle)

- 5 If you were making a scientific study of a problem, your first step should be the
 - A development of the hypothesis to be tested.
 - B design of the experiment to be conducted.
 - C selection of scientific equipment.
 - * D collection of information about the problems.

6.0 EXAMPLES OF QUESTIONS TO BEST UNDERSTANDING:

Q.6 If a piece of lead suspended from one arm of a beam balance with a piece of wood suspended from the other arm, why is the balance lost if the system is placed in a vacuum?

A The mass of the wood exceeds the mass of the lead.

*B The air exerts a greater buoyant force on the lead than on the wood.

C The attraction of gravity is greater for the lead than for the wood when both are in a vacuum.

D The wood displaces more air than the lead.

(Note: gives reason).

Q.7 Merchants and middle man should be classified as producers because they

A save money which can be used for the construction of good houses, rest houses, and temples.

B are regulators and determiners of price.

C aid in the distribution of goods and bring producer and consumer together.

D assist in the circulation of money.

(Note : gives reasons).

10.13.

Q.8 What does religious tolerance mean?

- A Admitting every one to the same church
- B Accepting religious teachings or faith
- C Altering religious belief so that it does not conflict with science
- D Allowing people to believe what they wish

(Note : analyses).

7.0 EXAMPLES OF QUESTIONS TO TEST APPLICATION:

Q.9 If an electric refrigerator is operated with the door open in a perfectly insulated sealed room, what will happen to the temperature of the room?

- A It will rise slowly
- B It will remain constant
- C It will drop slowly
- D It will drop rapidly

(Note . establishes cause effect relationship).

Q.10 How can one generate enough electric current to light a flashlight bulb?

- A By rubbing two good conductors of electricity together
- B By dipping two strips of zinc in sulphuric acid
- C By connecting the north pole of a magnet to the South Pole, using a coil of wire.
- D By rotating a coil of wire rapidly near a strong magnet.

(Note: Applies the principle in an unfamiliar situation).

Q.11 Statement of facts:

The following table represents the relationship between the yearly income of certain families and the medical attention they receive.

Family income	Percent of family members who received <u>no</u> medical attention during the year
Under Rs. 500	47
Rs. 500 - 1000	40
Rs. 1000 - 1500	33
Rs. 1500 - 2500	24
Above Rs. 2500	14

Conclusion : Members of families with small income are healthier than members of families with large incomes.

Assumption : Which one of the following must be assumed to make the above conclusion true?

- A Wealthy families had more money to spend for medical care.
 - B All members of families who needed medical attention received it.
 - C Many members of families with low incomes were not able to pay their doctor bills.
 - D Members of families with low incomes often did not receive medical attention.
- (Note : analyses to recognise the unstated assumption).

Q. 12 Why is adequate lighting necessary in a balanced aquarium?

- A Fish needs light to see their food.
- B Fish takes in oxygen in the dark.
- C Plants expel carbon dioxide in the dark.
- D Plants grow too rapidly in the dark.

(Note : judges the relevance of a procedure).

Q. 13 Which one of the following sentences is most appropriately worded for inclusion in an impartial report resulting from an investigation of a wage policy in a certain locality?

- A The wages of the working people are fixed by the one businessman who is the only large employer in the locality.
- B Since one employer provides a livelihood for the entire population in the locality, he properly determines the wage policy for the locality.
- C Since one employer controls the labour market in the locality, his policy may not be challenged.
- D In this locality, where there is only one large employer of labour, the wage policy of this employer is really the wage policy of the locality.

(Note : makes an evaluative judgement).

8. SUGGESTION FOR IMPROVING MULTIPLE CHOICE QUESTIONS:

After writing an item check up whether it is the best suitable form in which it could be asked or whether it can be improved further by (i) changing some alternatives, (ii) making the stem negative and reframing the alternatives, (iii) interchanging the key with the stem, or (iv) bringing in more variables in the stem in order to frame more plausible alternatives. An example is given below to demonstrate some of these suggestions.

Example:

Q. 14. Our body is made of cells. The cells are organised to make tissues. Some relationship exists between cells and tissues. The same relationship exists in one of the following:

- A between cell and organ.
- B between tissue and organ.
- C between organ and tissue.
- D between tissue and system.

- (i) (Note : In this question, alternatives 'B' and 'C' are equally correct and so one of them, e.g. 'C' may be reframed as "between organ and organism".

- (ii) The task is not comprehensively set in the stem and there is unnecessary repetition of "between " in the alternatives. Ther fore, by replacing "in one of the following" by "between", the stem can be improved.
- (iii) The stem contains unnecessary details which increases "reading lead". To make the stem brief as far as possible, it can be reframed as follows.

Q.14(a) Relationship between cell and tissue is the same as between

- A cell and organ.
- B tissue and organ.
- C organ and organism.
- D tissue and system.

Note: (i) Language of the stem is still not appropriate to avoid exceptions, if any. On this basis the stem needs to have "almost" before "the same".

- (ii) There is a scope to cover a wider content by framing suitable alternative from related sub-units or units. The question may, therefore, be reframed as follows.

Q. 14. (b) Relationship between cell and tissues is almost the same as between.

- A fat and carbohydrate.
- * B stomach and digestive system.
- C R.B.C. and W.B.C.
- D Stomach and intestine.

(Note: It is advisable to see if a better item can be obtained by turning round a formulated question into an answer

10.18.

and the answer into a question. For this, the question may be written as follows

Q.14 (c) Relationship between skeletal and digestive system is almost the same as between.

- A fat and carbohydrate.
- * B cell and tissue.
- C R.B.C. and W.B.C.
- D stomach and intestine.

This form appears to be more suitable if higher difficulty level of the question is desired than that of the original one.

CHAPTER 11

PREPARING A BALANCED QUESTION PAPER

A question paper is expected to test the pupil achievement with reference to the desired instructional objectives covering the content suitably. In this way, it is not just a random assortment of questions but rather based on a pre-determined pattern. In fact, it needs certain basic decisions which are to be made in advance. These decisions make the design of the question paper. On the basis of the design, the paper setter develops the blue print which is a three dimensional chart showing the placement of the different questions in respect of objectives, content area and forms of questions.

The preparation of design and blue print helps in developing a balanced paper giving due weightages to the pre-determined instructional objectives, various content areas and forms of questions. These weightages are decided in advance and help to overcome the problems of paper setter's subjectivity, poor content coverage and encouraging reliability of the test paper. The entire process of developing balanced questions papers involve six steps, namely 1. Preparation of design, 2. Preparation of a blue print, 3. Construction of questions based on the blue print, 4. Editing the question paper, 5. Preparation of the scoring key and marking scheme, and 6. Preparation of question-wise analysis. All of these are described here.

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1.0 PREPARATION OF A DESIGN

The design is not only the first, but also the most important step of paper setting. It lays down the chief dimensions of the question paper.

- 1.1 Weightage to objectives: This means the selection of objectives desired to be tested and allotting marks to each, in view of its importance. This will help reduce emphasis on memory and enable the testing of higher abilities.
- 1.2 Weightage to different areas of content: This entails the analysis of the syllabus, and the delimitations of the scope of each topic in the first instance and then the allotment of marks to each of the major areas for the purpose of framing questions.
- 1.3 Weightage to different forms of question : Working on the principle that for testing a particular ability and content the most suitable form of question should alone be used, we may like to choose different forms of questions for inclusion in the question papers instead of just one single traditional form viz. the essay type question. Having made this decision, the marks to be allotted to each form have also to be decided.
- 1.4 Scheme of options : The design may also indicate the pattern of options, i.e. the complete elimination or overall options and the limited retention of internal options, which among themselves may be comparable in respect of the objectives to be tested, the major area of content covered, the form of the question, the difficulty level of the question, etc.

1.5 Section in the question paper : The inclusion of objective type questions may necessitate the division of the question paper into sections and the allotment of a separate time limit for answering each. These questions are usually answered in a shorter time and need not remain with the pupils for longer than just the time necessary for attempting them.

In view of the above considerations the design may suggest the division of the question paper into two sections, both to be administered simultaneously, but the one containing objective type questions may be collected at the end of the given time limit.

2.0 PREPARATION OF A BLUEPRINT

A blueprint gives the details of the design in concrete terms. It is a three dimensional chart giving the placement of the different questions in respect of:

- (1) the objective tested by each,
- (2) the content area covered by each,
- (3) the form of question which is most suitable for testing 1 and 2 above.

In addition to the above three dimensions the blueprint may also indicate:

- (1) the numerical weightage to each question individually, and
- (2) the scheme of options to be adopted in framing the questions.

The blueprint is thus the detailed plan based on the design for preparing a question paper.

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3.0 PREPARATION OF QUESTIONS BASED ON THE BLUEPRINT

After the position of different questions is located on the blueprint, the next step is the preparation of questions, the dimensions of each of which have already been defined on an individual basis in the blueprint. By taking each location on the blueprint, individual questions have to be framed to satisfy the requirements of the respective positions.

The framing of questions based on the blueprint would necessitate the knowledge of objectives and specifications, a mastery over the subject matter and the skill in framing different form of questions.

While writing or selecting questions for the paper it may be kept in mind that the question:

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Within each section again, there could be sections based on the content area divisions. Whether there are sub-sections or not the questions have to be organised in a graded order of difficulty.

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question paper into sections based on forms of questions it may be necessary to give a specific time limit to the section containing fixed response type of questions.

This will help avoid chances of malpractices to a very great extent.

5.0 PREPARATION OF THE SCORING KEY AND THE MARKING SCHEME

Very often when we start thinking of the answers to particular questions we are able to discover mistakes in the questions, so it is essential to frame the scoring key and the marking scheme simultaneously with the framing of the question paper. The scoring key is to be prepared for the objective type questions and the marking scheme for the essay and short answer questions. The marking scheme, gives the expected outline of the answer and the marks that each point or aspect of the answer deserves. In case there are more points than provided for in the marking scheme and the student has the freedom to choose only a limited number of them, we may indicate that any of the points given in the expected answer or similar other points given by them may be taken as correct. As far as possible effort should be made to give all the points that may be relevant to the question irrespective of the number asked for in the question.

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- (4) Sub-topic covered by the question.
- (5) Form of the question.
- (6) Estimated difficulty level. (Easy or Average or Difficult)
- (7) Approximate time required for answering.
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These details are given in a tabular form and each column of the table can be summarised to give us the distribution of questions either on the different objectives, or the areas of content or the forms of questions, etc.

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C H A P T E R -12

SAMPLE UNIT TEST

- A. Design
- B. Blue Print
- C. Question Placement Chart
- D. Question Paper for Unit Test
- E. Scoring key and Marking Scheme
- F. Question-wise Analysis

(a) DESIGNTITLE: FLOWER STRUCTURE AND FUNCTION
(UNIT No. 4)

CLASS: IX
 TIME : 40 Minutes
 MARKS: 25

1. Weightage to Objectives:

OBJECTIVES	K	U	A	S	TOTAL
MARKS	<u>8</u>	<u>10</u>	<u>5</u>	<u>2</u>	<u>25</u>

2. Weightage to Form of questions:

FORMS OF QUESTIONS	E	SA	VSA	O	TOTAL
No. of QUESTIONS	1	5	5	5	16
MARKS Allotted	5	10	5	5	25
ESTIMATED TIME	12	15	5	5	37+3

3. Weightage to content, Sub-units:

	MARKS
1.1 Parts of a flower	5
1.2 Pollination	7
1.3 Fertilization	8
1.4 Fruit and Seed formation	5
TOTAL	<u>25</u>

4. Scheme of Sections Nil5. Scheme of options Nil6. Weightage to difficulty level:

Difficult 28% Average 44% Easy 28%

(B) BLUE PRINT

Class : IX

Unit : Flower Structure and Function

Time : 40 minutes

Maximum Marks : 25

Sub Unit No.	Objectives			Knowledge			Understanding			Application			Skill			Total
	E	SA	VSA	O	E	SA	VSA	O	E	SA	VSA	O	E	SA		
1.1 Parts of a Flower	-	-	1(1)	1(1)	-	2(1)	-	-	-	-	-	1(1)	-	-	4(1)	5(4)
1.2 Pollination	-	2(1)	-	-	-	2(1)	1(1)	1(1)	-	-	1(1)	-	-	-	-	7(5)
1.3 Fertilization	-	-	-	1(1)	1(1)	2(1)	2(1)	-	-	2(1)	2(1)	-	-	2(-)*	-	8(3)
1.4 Fruit and Seed formation	-	2(1)	-	1(1)	-	-	1(1)	-	-	-	1(1)	-	-	-	-	5(4)
Sub Total	-	4(2)	1(1)	3(3)	3(1)	4(2)	2(2)	1(1)	-	2(1)	2(2)	1(1)	2(-)	-	-	25(16)
Total			8(6)			10(6)				5(4)		2(-)				

Note : Figures within brackets indicate the number of questions and figures outside the brackets indicate marks.

*Denotes that marks have been combined to form one question.

Summary: Essay (E) or (LA) No. 1 Marks: 5
 Short answer (SA) No. 5 Marks: 10
 Very Short Answer (VSA) No. 5 Marks: 5
 Objective (O) No. 5 Marks: 5

Scheme of Options: Nil
 Scheme of Section: Nil
 Difficulty: 28% Average
 44% Easy 28%

(c) QUESTION PLACEMENT CHART

Unit Flower Structure and Functions

M.M. 25

Class IX
Time 40 Mts.

Sub-Unit No.	Knowledge			Understanding			Applications			Skill		Total
	E	SA	VSA	E	SA	VSA	E	SA	VSA	E	SA	
1.1	-	-	6	1	-	13	-	-	-	-	-	5(4)
1.2	-	11	-	-	14	7	4	-	-	-	-	7(5)
1.3	-	-	-	2	16*	4	4	15	4	16*	-	8(3)
1.4	-	12	-	3	-	8	-	-	10	-	-	5(4)
Sub-total	4(2)	1(1)	3(3)	3(3)	30*	2(2)	1(1)	2(1)	2(2)	1(1)	1(2)	-
Totals	8(6)			10(6)				5(4)			2(1)	

E 5(1)
SA 16(5)
VSA 5(1)
OT 5(5)

(D) QUESTION PAPER FOR THE UNIT TEST

Subject : Biology
 Unit : Flower Structure and Function
 Class : IX
 Time : 40 minutes
 Marks : 25

INSTRUCTIONS:

1. All questions are to be attempted.
2. Q. Nos. 1-5 are Multiple-choice type. Indicate your answer by mentioning the alphabet given against the selected choice alongwith the question number in your answer-book.
3. Q. Nos. 6-10 are very short answer questions. Answer them in about 1-15 words.
4. Question Nos. 11-15 are short answer type. Answer them in about 30-50 words.
5. Q.No. 16 is Essay type question. Answer the same in about 100-150 words.

Q.1. The structure which connects the stigma to ovary is called as

- A. Connective.
 - B. style.
 - C. ovule.
 - D. anther.
- 1

Q.2. Porogamy means entry of pollen tube into the embryo sac through

- A. chalaza.
 - B. hilum.
 - C. micropyle.
 - D. stomata.
- 1

Q.3. Which of the following stages involves a reduction division in the life cycle of a flowering plant?

- A. Formation of pollen tube.
 - B. Formation of embryo sac.
 - C. Germination of seeds.
 - D. Division of the generative nucleus.
- 1

- Q.4. Two examples of Zygomorphic flower are
- A. coral tree and maize
 - B. rose and rose-apple
 - C. coral tree and rose-apple 1
 - D. rose and silk cotton tree
- Q.5. A student collects several flowers from different types of plants. On examination he finds that some have both stamens and carpels while others are with either stamens or carpels. Which of the following generalization can be best drawn on the basis of these observations?
- A. Monoecious plants bear unisexual or bisexual flowers.
 - B. Dioecious plants bear male or female flowers.
 - C. Plants are either monoecious or dioecious.
 - D. Flowers are unisexual or bisexual. 1
- Q.6. Give two usual functions of calyx of entomophilous flowers. 1
- Q.7. Why do the nocturnal flowers emit scent instead of developing bright colours? 1
- Q.8. Suppose the tube nucleus of a germinating pollen grain contains 7 chromosomes. What would be the normal number of chromosomes in its generative nucleus and the resulting cells of the endosperm? 1
- Q.9. Under what conditions a fig tree bearing several inflorescences when grown in a glass house will not be able to get its flowers pollinated? 1
- Q.10. In an experiment, a plant breeder selects three young flowers of a plant. He covers the stigmas of two flowers marked A and B to prevent pollination but keeps the flower C uncovered to allow natural pollination. He injects a hormone into the ovary wall of flower A. After 15-20 days, the flowers A and C develop normal fruits while the flower B withers. Develop a suitable hypothesis which could explain these results. 1
- Q.11. State any four advantages of cross pollination over self-pollination. 2
- Q.12. How does the fruit formation help the plant? State two advantages only. 2

- Q.13. A student collects four types of-flowers marked A, B, C and D. On examining them, he finds that flower A has calyx and corolla with free sepals and free petals, flower B with free sepals and fused petals, flower C with sepals and petals fused, and flower D with fused sepals and free petals. Classify them in four categories using forking system on the basis of free or fused sepals and petals. 2
- Q.14. Explain how the male flowers transfer their pollen grains on the stigma of the female flowers in Vallisneria. 2
- Q.15. A student transfers mature pollen grains on to the stigma of the same flower but fails to effect fertilization. Give two possible reasons to explain this result. 2
- Q.16. With the help of a labelled diagram, explain how angiosperms involve a double fertilization. 2+3
-

(E) SCORING KEY AND MARKING SCHEME

Q.No.	Key/Value Points	Value point wise Marks	Total Marks
1	B	1	1
2	C	1	1
3	B	1	1
4	C	1	1
5	D	1	1
6	i) provides protection to the inner whorls of the flower in bud stage. ii) photosynthesizes when green and leafy.	1/2 1/2	1
7	to help insects to locate flowers in the darkness as colours are not visible.	1	1
8	i) generative nucleus; 7 chromosomes ii) cells of endosperm; 21 chromosomes	1/2 1/2	1
9	In the absence of insects in the glass house.	1	1
10	The pollination followed by fertilization produces a hormone sufficient enough to initiate fruit formation.	1	1
11	i) healthier progeny to withstand the environment better. ii) better germinating capacity. iii) more viable seeds. iv) better opportunities for producing new varieties.	1/2 1/2 1/2 1/2	2

Q.No.	Key/Value Points	Value point wise Marks	Total Marks
12	i) protects immature seeds from the adverse environmental conditions ii) helps in disposal of seeds to increase chances for favourable conditions needed for seed germination and growth.	1 1	2
13	<p>Sepals $\begin{cases} \text{free (AB)} & \begin{cases} \text{petals free (A)} \\ \text{Petals fused (B)} \end{cases} \\ \text{FUSED (CD)} & \begin{cases} \text{Petals free (D)} \\ \text{Petals fused (C)} \end{cases} \end{cases}$</p> <p><u>OR</u></p> <p>Petals $\begin{cases} \text{free (AD)} & \begin{cases} \text{Free Sepals (A)} \\ \text{Fused Sepals (D)} \end{cases} \\ \text{Fused (BC)} & \begin{cases} \text{Free Sepals (B)} \\ \text{Fused Sepals (C)} \end{cases} \end{cases}$</p>	<p>1/2 1/2 1/2 1/2</p> <p>2</p>	2
14	i) Female flowers when mature are raised to surface of water with trifid stigmas open. ii) Detached male flowers float on the surface of water being light. iii) Anthers dehisce releasing sticky pollens on the stigmas when male flowers come in contact with female flowers. iv) Stigmas close up after receiving the pollens.	1/2 1/2 1/2 1/2	2
15	i) The stigma is not yet mature and so fails to induce pollen germination. ii) The pollens have no fertilizing effect on the stigma of the same flower being self-sterile OR The pollens fail to germinate even on the mature stigma due to its inhibitory effect on pollen germination.	1 1	2

Q.No.	Key/Value Points	Value point wise-Marks	Total Marks
16	(a) <u>Sequential steps to accomplish double fertilization:</u>		
	i) Germination of pollen grain after receiving stimulation from the stigma.	1/2	
	ii) Production of two viable male nuclei (or gametes) in the pollen tube from the generative nucleus by mitosis.	1/2	
	iii) Growth of pollen tube and its entry into the ovule.	1/2	
	iv) Dissolution of the tip of the pollen tube and release of the two male nuclei in the embryo sac.	1/2	
	v) Fusion of one of the male nuclei with the egg cell to produce 2x zygote (or oospore) → the first fertilization.	1/2	
	vi) Fusion of the second male nuclei with the definitive nucleus to produce primary endosperm nucleus → the second fertilization.	1/2	
	(b) <u>Diagram:</u>		
	Any of the four parts of the following drawn and labelled correctly	1/2x4 =2	
	i) pollen tube		
	ii) egg cell		
	iii) definitive nucleus		
	iv) embryo sac		
	v) ovule		
	vi) ovary		5

(F) QUESTION WISE ANALYSIS

Q.No.	Objective	Specification	Sub Unit No.	Form of Ques.	Marks	Time mts	Difficulty level
1.	K	recognises.	1.1.	C	1	1	C
2	K	recognises	1.3.	O	1	1	C
3.	K	recognises	1.4.	O	1	1	B
4.	U	Cites examples	1.2.	O	1	1	B
5	A	Generalizes	1.1.	O	1	1	A
6	K	recalls	1.1.	VSA	1	1	C
7	U	explains	1.2.	VSA	1	1	B
8	U	calculates	1.4.	VSA	1	1	B
9	A	Analyses	1.2.	VSA	1	1	A
10	A	Hypothesizes	1.4.	VSA	1	1	A
11	K	recalls	1.2.	SA	2	3	C
12	K	recalls	1.4.	SA	2	3	C
13	U	classifies	1.1.	SA	2	3	A
14.	U	explains	1.2.	SA	2	3	B
15	A	hypothesizes	1.3.	SA	2	3	A
16	U S	explains draws	1.3.	E	5	12	B

A Difficult

B Average

C Easy

LIST OF INSTRUCTIONAL OBJECTIVES FOR HIGHER
SECONDARY SCHOOL BIOLOGY

1.00 KNOWLEDGE

The pupil acquires knowledge of the content elements like terms, facts, techniques, processes, classifications, concepts, principles and generalizations related with the subject.

SPECIFICATIONS:

1.10. The pupil recalls the content elements.

1.20. The pupil recognises the content elements

2.00 UNDERSTANDING:

The pupil comprehends the various content elements, i.e. terms, facts, techniques, processes, classifications, concepts, principles and generalisations.

SPECIFICATIONS:

2.10. The pupil translates content elements from one form to another.

2.20. The pupil cites examples involving one or more content elements.

2.30. The pupil identifies relationships between two or more content elements.

2.40. The pupil detects error in statements, diagrams, etc.

2.50. The pupil compares one or more content elements to report similarities and differences.

2.60. The pupil classifies various content elements on the basis of given or evolved criteria.

2.70. The pupil interprets various types of data and concepts related to the content.

2.80. The pupil explains the various content elements like processes, techniques, cause-effect relationship etc.

2.90. The pupil extrapolates for the future on the basis of given facts, data etc.

3.00. APPLICANT (Application, Analysis, Sythesis and Evaluation of Bloom's model).

The pupil applies knowledge and understanding of the various content elements in unfamiliar situations.

SPECIFICATIONS:

- 3.10. The pupil analyses the given data or situations to identify the various components and their relationships.
- 3.20. The pupil formulates hypothesis(or most suitable explanations) on the basis of given or observed data.
- 3.30. The pupil suggests an appropriate and alternative procedures or plan of action for the given purpose.
- 3.40. The pupil gives reason(s) for certain causes and effects.
- 3.50. The pupil infers from the given data.
- 3.60. The pupil generalises on the basis of his observations or given data.
- 3.70. The pupil predicts from the observed and/or given data.
- 3.80. The pupil judges the relevance, adequacy, and consistency of the facts, principles and generalization in the given statements, data, procedures, processes etc.

4.00 SKILLS:

The pupil develops skills in observing, drawing, conducting experiments, collecting preserving and displaying exhibits, reporting etc.

SPECIFICATIONS(According to various types of skills)

4.10. Observational skills:

- 4.11. The pupil notices/recognises relevant details in diagrams, specimens, chemical changes, phenomena, processes, procedures, apparatuses, instruments, etc. carefully(Keen observation)
- 4.12. The pupil reads the instruments, graphs, tables, etc. precisely and methodically(Quantitative observation).

- 4.13. The pupil locates the desired information structures, materials, phenomena, etc. exactly. (Precise Observation)
- 4.14. The pupil discriminates between closely related data, structures, specimens, organisms, etc. (Comparative Observation).
- 4.15. The pupil detects errors in experimental procedures, apparatuses, instruments, etc. (Evaluation Observation)
- 4.20. DRAWING SKILLS:
- 4.21. The pupil draws diagrams, figures, graphs, maps, tables, charts from the given material/data faithfully neatly, proportionately, to the desired scale and with reasonable speed.
- 4.22. The pupil labels diagrams, maps, charts, etc. methodically, neatly, legibly and correctly.
- 4.23. The pupil completes diagrams, graphs, figures etc. correctly which are incompletely drawn.
- 4.24. The pupil traces figures and electric circuits, etc. accurately.
- 4.25. The pupil shows directions in flow charts, action diagrams, etc. correctly & methodically.
- 4.30. MANIPULATIVE SKILLS:
- 4.31. The pupil selects apparatus, chemicals, materials etc. appropriately.
- 4.32. The pupil handles the apparatus, chemicals etc. carefully.
- 4.34. The pupil measures (reads) quantities with correct procedure and precision.
- 4.35. The pupil maintains instruments, apparatuses, chemicals, specimens, etc.
- 4.36. The pupil improvises apparatus/techniques as per requirement.
- 4.37. The pupil sets the experiment carefully, systematically with a reasonable speed.
- 4.38. The pupil performs the experiment methodically and with accuracy and reasonable speed.

- 4.39. The pupil takes necessary precautions and safety measure in handling instruments, chemicals etc.,
- 4.40. COLLECTING, MOUNTING, PRESERVING AND DISPLAY SKILLS:
- 4.41. The pupil locates the place of occurrence easily.
- 4.42. The pupil collects materials, specimens, etc. efficiently, economically, methodically, and timely.
- 4.43. The pupil uses the apparatuses, instruments, chemicals, etc. for collection, mounting, preservation and display economically and efficiently.
- 4.44. The pupil mounts the specimens, etc. appropriately and effectively.
- 4.45. The pupil selects appropriate chemicals, instruments for collecting, mounting, preservation, graphs, exhibits, etc. effectively.
- 4.46. The pupil displays his collections, charts, maps, graphs, exhibits, etc. effectively.
- 4.50. REPORTING SKILLS:
- 4.51. The pupil records observations, data, etc. faithfully, systematically and according to the design of the experiment.
- 4.52. The pupil selects appropriate terminology, graphs, figures, formulas, formulae, chemical equations, symbols and principles for writing the report of the experiment.
- 4.53. The pupil presents principles involved, methods and materials, observations, data, calculations, analysis and interpretations, conclusions, limitations, and precautions systematically, coherently, succinctly and evaluatively.
- 4.54. The pupil uses simple, clear, precise and unambiguous language in the report.
- 4.55. The pupil develops a summary of the report of work and findings.
- 4.56. The pupil displays his results, exhibits, etc. effectively and appropriately.

5.00 APPRECIATIONS:

The pupil appreciates natural phenomenon and laws, contributions of subject experts and their achievements, role of the subject in human life, etc.

SPECIFICATIONS:

- 5.10: The pupil develops an awareness of science and its contributions (in human welfare).
- 5.20. The pupil recognises interdependence in life, unity and life to diversity of forms, etc.
- 5.30. The pupil obeys the instruction, rules, etc. in his work.
- 5.40. The pupil realizes the worth of scientists and their contributions, etc.
- 5.50. The pupil admires the beauty of nature and its organizational laws, etc.

6.00 INTERESTS:

The pupil develops interest in the living world.

- 6.10. The pupil is conscious of the scientific development and its impact on human life.
- 6.20. The pupil listens the scientific talk with interest.
- 6.30. The pupil reads scientific magazines voluntarily to seek new information.
- 6.40. The pupil collects materials of scientific interest.
- 6.50. The pupil visits places of scientific interest.
- 6.60. The pupil enjoys participation in scientific activities, hobbies related to science, etc.
- 6.70. The pupil initiates discussion on topics of scientific interest.
- 6.80. The pupil writes scientific articles for the press.

7.00 ATTITUDES AND ADJUSTMENTS:

(1) The pupil develops the scientific attitude towards the nature, natural phenomenon and personal and social life.

(2) The pupil develops adjustment to modify the environment or to himself.

S P E C I F I C A T I O N S :

- 7.10. The pupil practices the rules and regulations of scientific work voluntarily (compliance of instructions).
- 7.20. The pupil believes in cause-effect relationship (both in the power of reason).
- 7.30. The pupil observes intellectual honesty in his work and life.
- 7.40. The pupil suspects judgement in the absence of adequate and appropriate evidence.
- 7.50. The pupil devotes time to convince others for following scientific reason in solving problems, for conservation of natural resources and maintenance of balance in nature etc.
- 7.60. The pupil changes his opinions when convinced by others (open-mindedness).

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(A) D E S I G N

TITLE _____
(UNIT NO. _____)

CLASS : _____

TIME : _____ Minutes

MARKS : _____

1. Weightage to Objectives

OBJECTIVES	K	U	A	S	TOTAL
MARKS	_____	_____	_____	_____	_____

2. Weightage to Form of questions:

FORMS OF QUESTIONS	E -	SA	VSA	O	TOTAL
NO. OF QUESTIONS	_____	_____	_____	_____	_____
MARKS ALLOTTED	_____	_____	_____	_____	_____
ESTIMATED TIME	_____	_____	_____	_____	_____

3. Weightage to content:

CONTENT SUB-UNITS	MARKS
1.	_____
2.	_____
3.	_____
4.	_____
5.	_____
6.	_____
7.	_____
8.	_____
9.	_____
10.	_____
TOTAL	

4. Scheme of Sections - _____

5. Scheme of Options _____

(B) BLUE PRINT

Time : _____

Unit : _____
Max. Marks: _____

Max Marks:

NOTE : Write the appropriate question number in the column representing its content, sub-

Write the appropriate question number in the column representing its content, sub-unit, form of question and the objective. Use the following sequence while allocating question numbers.

$$\begin{array}{llll} \text{O} & \text{K} & \{ \text{sub_unit wise} \}, & \text{A} \{ \text{sub_unit wise} \}; \\ \text{VSA} & \text{K} & \{ \text{sub_unit wise} \}, & \text{A} \{ \text{sub_unit wise} \}; \\ \text{SA} & \text{K} & \{ \text{sub_unit wise} \}, & \text{A} \{ \text{sub_unit wise} \}; \\ \text{E} & \text{K} & \{ \text{sub_unit wise} \}, & \text{A} \{ \text{sub_unit wise} \}; \end{array}$$

(B-4)

(D) ITEM WRITING SHEET

SUBJECT _____ UNIT _____
OBJECTIVE _____ SUB-UNIT _____
SPECIFICATION _____ FORM OF QUESTION _____
MARKS _____
ESTIMATED TIME _____ EST. DIFFICULTY
LEVEL _____

Name of the Item Writer _____

P.T.O.

Address _____

(E) SCORING KEY AND MARKING SCHEME

Note: Give key for the objective questions, complete expected answers for very short and Short Answer questions, and outline answers prepared value-point wise for the essay type questions.

[illegible]

(B-6)

(F) QUESTION WISE ANALYSIS

S. No.	Objective	Speci- fication	Unit or sub- unit	Form of ques- tions	Marks f allo- tted	Time- estimated	difficu level

APPENDIX - III

SUGGESTED READINGS

1. Agarwal, J.P. Technique of Item Writing (Biological Science); A mimeographed handbook. DMES&DP, NCERT, 1984
2. Bloom, B.S. et al. Taxonomy of Educational Objectives: Handbook - 1 The Cognitive Domain, New York, David McKay, 1956.
3. Bloom, B.S., Hastings, J., and Madaus, G.P. Handbook on Formative and Summative Evaluation of Students Learning, New York, Mc Grow Hill, 1971.
4. Black, Harry and Broadfoot, P. Keeping Track Teaching, Routledge Kigant & Paul, 1982.
5. Chase, C.L. Measurement for Educational Evaluation Reading, Mass, Addison-Wesley, 1973.
6. Dave, R.H. and Patel, P.M. Educational Evaluation and Measurement, New Delhi, N.C.E.R.T., 1972.
7. Ebel, Robert L. Essentials of Educational Measurements and N.J., Prentice Hall, 1979.
8. Engelstion, J.F. and Ferr, J.F. Studies in assessment, London, English University Press, 1969.
9. Gronlund, N.D. Preparing Criterion Referenced Tests for Classroom Instruction. New York, Macmillan, 1973.
10. Gronlund, N.E. Measurement and Evaluation in Teaching, 3rd ed. New York, Macmillan, 1976.
11. Karmel, Louis J., and Karmel, Marylin O. Measurement and Evaluation in the Schools, 2nd ed. New York, Macmillan, 1978.
12. Krathwohl, D.R., et al. Taxonomy of Educational Objectives : Handbook II - The Affective Domain. New York, David McKay, 1964.

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15. Mehrens, William A., and Lehmann, Drvin J. Measurement and Evaluation in Educational and Psychology. New York, Holt, Rinehart & Winston, 1975.
16. Noll, V.H., et al. Introduction to Educational Measurement. Beston, Houghton Mifflin, 1979.
17. Pophams, W. James. Criterion-Referenced Measurement. N.J., Prentice Hall, 1978.
18. Popham, W. James. Modern Educational Measurement, N.J., Prentice Hall, 1981.
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20. Singh, Pritam. Criterion Refrenced Testing. New Delhi, N.C.E.R.T. 1982
21. Srivastava, H.S. Examination Reforms in India. Paris, UNESCO, 1979.
22. Stanley, J.C., and Hopkins, K.D. Educational and Psychological Measurement and Evaluation, 5th ed. N.J., Prentice Hall, 1972.
23. Tuckman, Bruce W. Measuring Educational Outcomes; Fundamentals of Testing. San Francisco, Harcourt Brace J., 1975.

